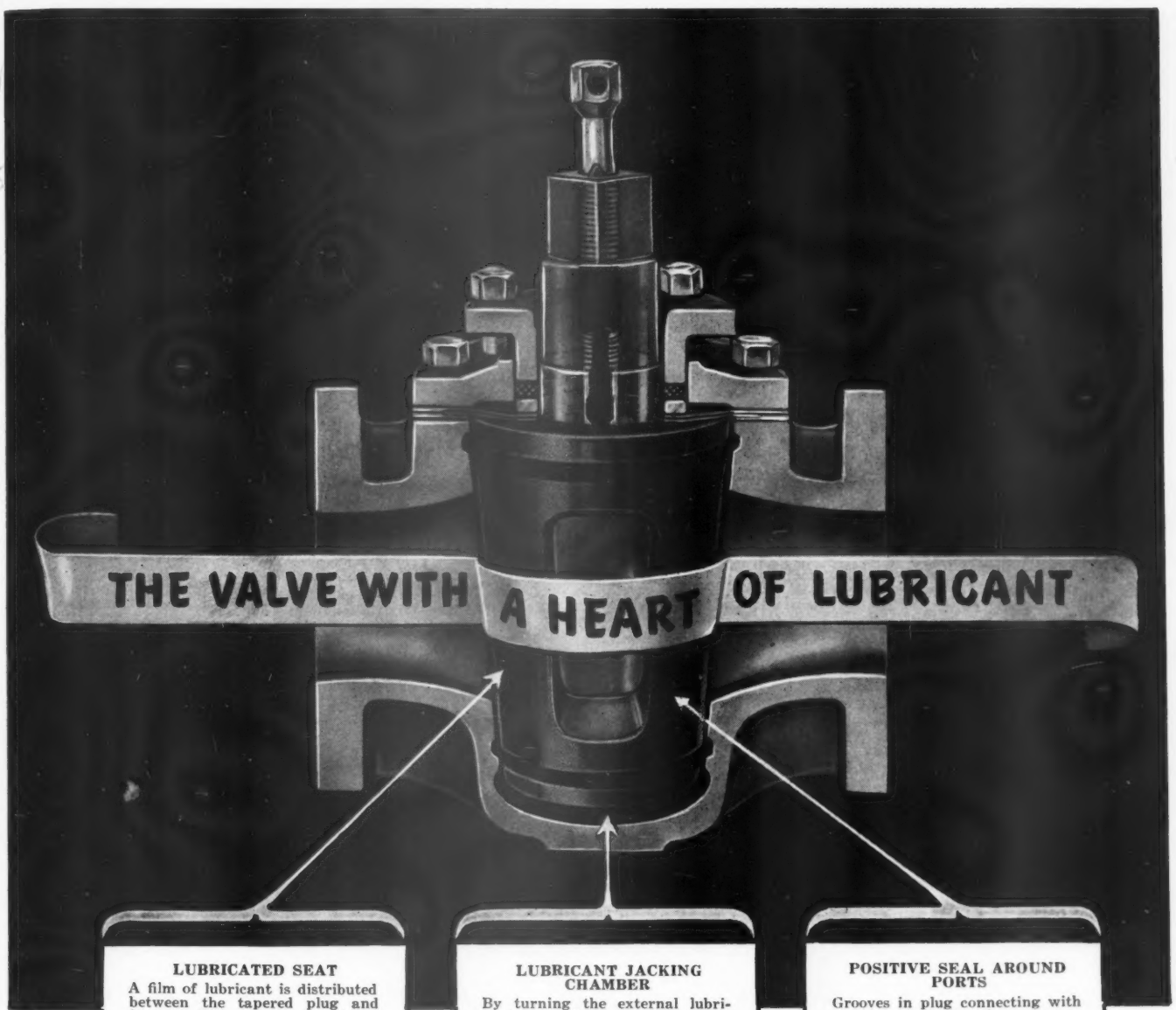
the
Engineer

international monthly

devoted to petroleum operating practices



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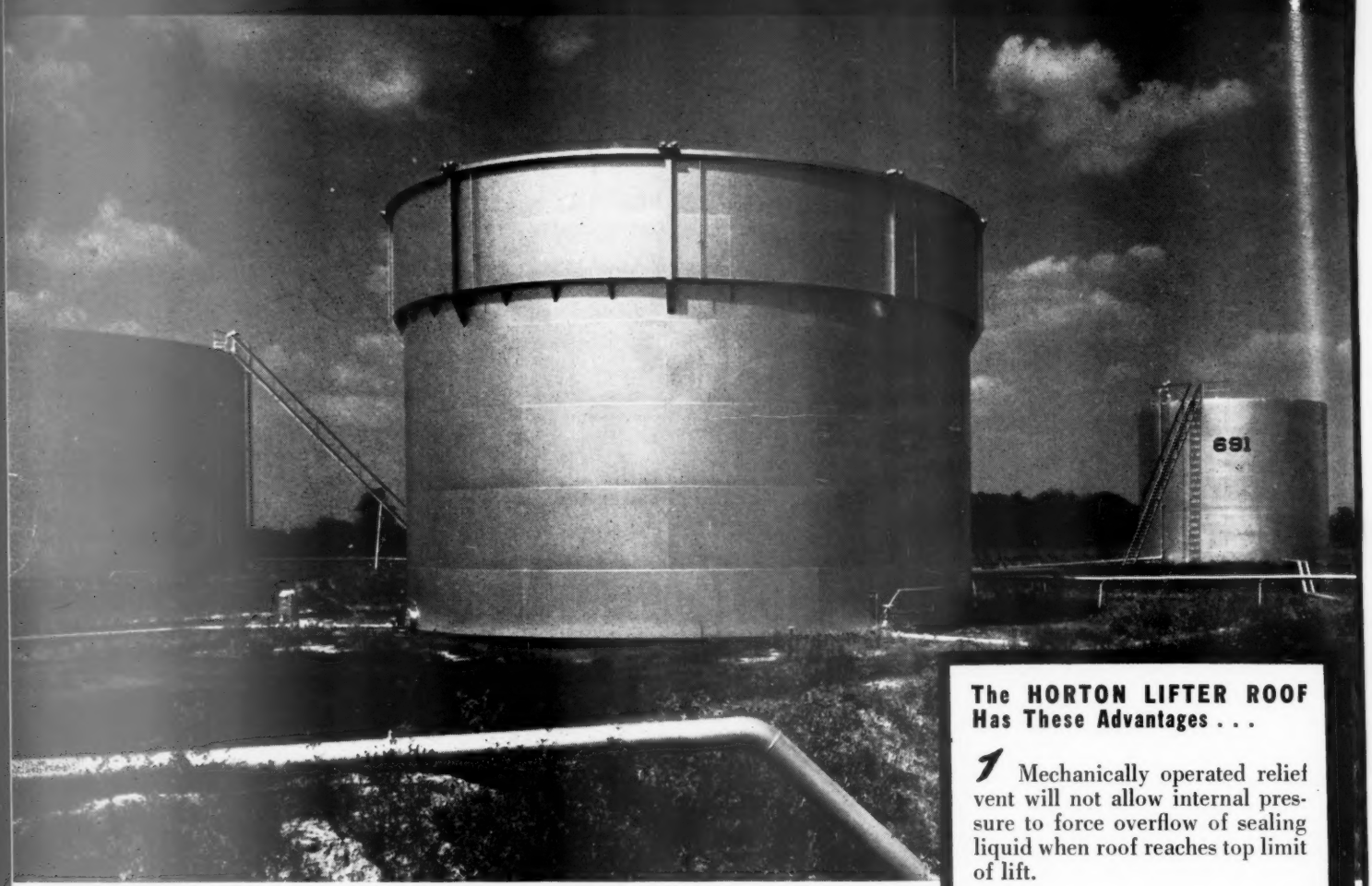

The above view, taken at a products pipe line terminal in Texas, shows a 30,000-bbl. tank equipped with a Horton Liquid-Seal Lifter Roof. The vapor spaces of adjacent cone-roof tanks are connected by large-diameter vapor piping to the expansible vapor space under the Lifter Roof. When rising temperature causes the air-vapor mixture to expand in the Lifter Roof tank, and the fixed-roof tanks connected to it, the roof moves upward on the expanding vapor. When the vapor contracts, the roof rides back down. This permits the vapor mixture in the tank to expand and contract without drawing in fresh air or venting air and vapor, and as a result, "breathing" losses are stopped.

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the Petroleum Engineer

DECEMBER • 1948

VOLUME XX NUMBER 3

...ds for Operating Men

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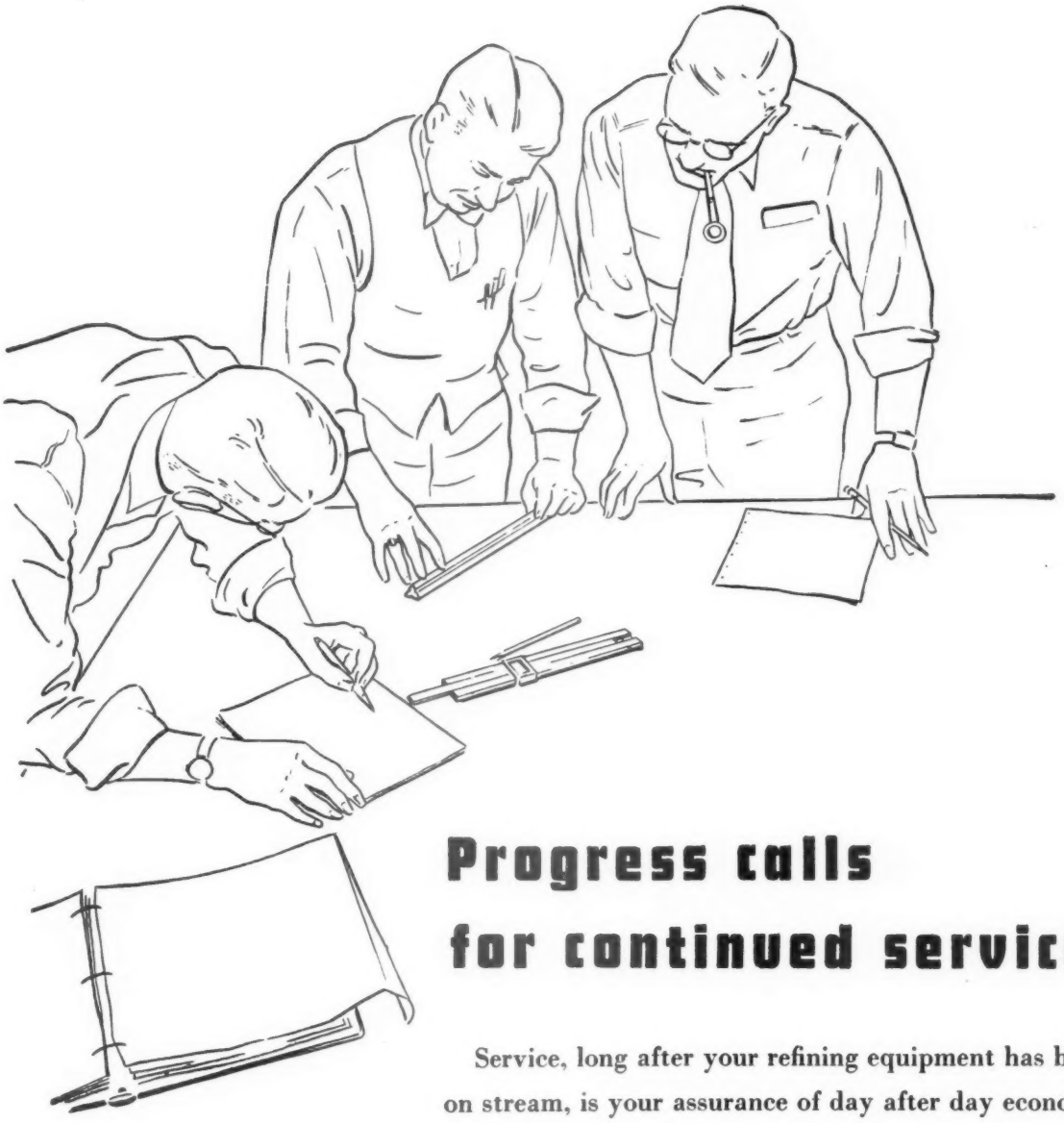
Flare Gas Dilemma

Quite aside from its value as a fuel or as a raw material in the manufacture of chemicals or the synthesis of other hydrocarbons, natural gas plays an important role in the production of oil. In solution in or associated with the oil in the reservoir, gas is the most valuable source of natural energy in producing operations. By a skillful control and handling of this gas, the ultimate yield of oil can be substantially increased and lifting costs materially reduced. This is done by returning to the reservoir the gas produced with the oil so as to maintain the optimum reservoir pressure required for efficient production. Of all the oil fields now producing there are many that would benefit were all available gas produced with the oil returned to the reservoir. The fact is, however, that it is not always economically feasible to do so.

This is one of the main points at issue in Texas, where the Railroad Commission has issued orders to shut down certain fields in which the volume of gas produced with the oil is believed by the Commission to be great enough to make it economically feasible for the operators to gather the gas and use it for some lawful purpose. From the standpoint of conservation and prevention of underground waste, the Commission is on firm ground. The orders, however, place many operators in a dilemma. During the war, they concentrated on maximum oil production regardless of efficiency. They are now confronted with economic factors involving group action, shortages of materials, and the time element required for installing facilities essential for handling the gas. They are also confronted with legal problems that are beyond the power of any one operator to solve in his own behalf. Because of the critical postwar oil supply and demand situation, the flaring of gas is regarded as a temporary problem and one that cannot be eliminated overnight without running the risk of creating a grave national shortage of petroleum products.

Granted enough time, the flaring of gas can be eliminated. Operators are keenly conscious of the fact that flaring of gas goes against the industry's excellent record and does not help its relations with the public. The Commission's orders will have a salutary effect in intensifying the efforts of operators to put an early end to this problem. Its elimination will redound to the good of the individual operator, the oil industry, and the public.—K. C. S.



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Scanning WASHINGTON'S OIL HORIZON

By MILBURN PETTY

WASHINGTON—There is a growing optimism that some sort of voluntary program will be worked out to allocate additional steel to make more line pipe and oil country tubular goods for the oil and gas industries.

Commerce Department's steel products advisory committee is now surveying pipe mills to determine what capacity is idle for lack of steel. When this study is finished the steel industry group will meet with representatives of the National Petroleum Council to develop a voluntary allocations plan.

▸ **Steel.** Meanwhile, the Council has been asked by Interior Secretary Krug to consider action on "the problem of shortages, exportations, and maldistribution of steel materials." Out of this may come some sort of voluntary plan for a "pool" of pipe and tubular goods to take care of hardship cases.

The steel industry committee reconsidered its turndown of the oil-steel plan after receiving a personal appeal from Secretary Krug who denied that "we have oil running out of our ears." He said supply and demand were approximately in balance but this could be upset by any one of a number of unpredictable happenings.

▸ **Drilling.** "From the national security standpoint," Krug said in a letter to Commerce Secretary Sawyer arguing for more steel for oil, "we have lost ground this past year. Instead of domestic supply equaling domestic demand, we are a net importer of 100,000 bbl a day. Every effort should be made to erase this deficit and to increase production above demand to help carry the energy load of an emergency. We should have at least 1,000,000 bbl a day excess productive capacity to fuel another war. We can only get it by drilling more wells. We can not drill more wells without more oil country tubular goods.

"Equally important, to both the domestic economy and national security, is pipe for oil and gas lines," Krug continued. "Little is gained by increasing output of crude oil or products unless adequate pipe lines are provided to move the crude oil to the refineries and to move the products from the refineries to centers of distribution."

▸ **Oil Policy.** Line pipe availability was lengthily discussed at the NPC's national oil policy committee meeting at Chicago recently. Some very large independent producers were worried because they had been told by one pipe mill after another that their output for several years had been contracted for. Result was the inclusion of a new plank in the NPC's proposed platform declaring that adequate supplies of materials should be equitably available to all without resort to government control.

Briefly, other highlights of the proposed report, as approved at Chicago, include: Maintenance of a healthy, vigorous domestic industry will assure the reserves and facilities needed in event of war. Stockpiling imported oil is impractical; but stockpiling of military products is desirable and feasible. Arbitrarily cutting back production to build up a reserve would impede development here. Free markets and suitable tax laws will assure the industry's expansion to meet demands. Maximum effort should be made to promote discoveries in the U. S. Imports should merely supplement domestic production. Synthetic fuels can best be developed by private industry. Conservation measures such as unit operation, secondary recovery, etc., should be encouraged.

▸ **Interior.** Choice of a successor to Max W. Ball as director of Interior's Oil and Gas Division has apparently narrowed down to either W. W. Vandeveer, Cleveland, or Major J. R. Parten, Houston, (if either is willing to accept). Both served in PAW during the war. Both recently disposed of their holdings in Allied Oil Company, Inc., and Premier Refining Company, respectively. Both have had experience in all branches of the industry. Vandeveer's interest has been mainly refining and marketing; Parten's, mainly production and transportation.

▸ **Divorcement.** Legislation for disintegration of the major oil companies is certain to be introduced at the coming session of Congress. And at least two congressional groups map actually recommend this drastic step in their reports to Congress. They are the Senate and the House small business committees.

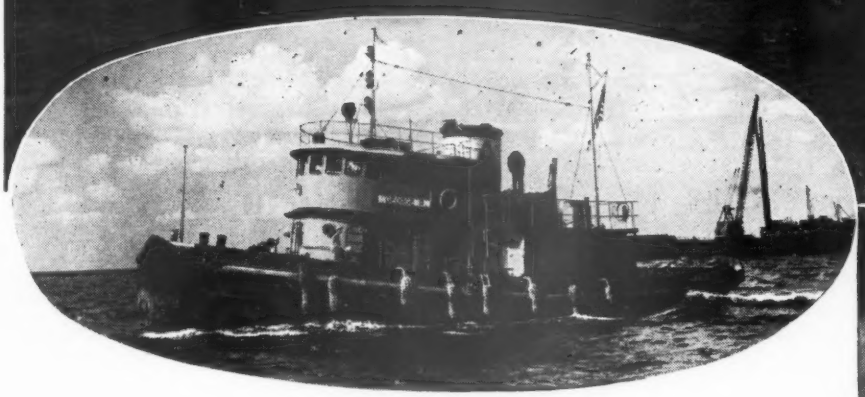
Tentative draft of the report for Senator Wherry's committee includes the proposal that (1) marketing be divorced from production and refining, (2) pipe lines be divorced from their shipper owners and (3) tankers be separated from oil company ownership and control. This proposed report also suggested that Congress take steps to prevent "phantom freight" from being collected by refiners shipping by pipe line and allegedly charging the rail rate.

The House Small Business Committee, to be headed by Congressman Patman, Texas, has before it the question of whether it should recommend divorcement for the oil, steel, and movie industries. Patman also wants to look into complaints from independent producers that the major oil companies seem to have no difficulty in obtaining pipe although small operators cannot get enough to keep going.

▸ **Controls.** Oil, along with other fuels, was included in drafts of proposed bills for standby controls—price regulation, allocation, and rationing—which some White House advisers are urging upon President Truman. Such powers would be invoked only when needed to prevent further inflation, these advisers say. Truman may suggest such standby controls to Congress but he probably will ask that industry generally be first given a chance to accomplish the same objective through voluntary action.

▸ **Tidelands.** Discussions are going on at high levels, initiated by President Truman, regarding the next step in the tidelands issue. The big question is whether or not the new suits can be filed against Texas and Louisiana without endangering the chances of a bill for federal leasing of the tidelands, such as was introduced last winter by Senator Barkley, Kentucky. Only possible chance for enactment of a resolution quitclaiming offshore submerged lands to the States is to convince Truman that this would mean speedier development, which is so much desired by the military. On the other hand, the federal leasing bill faces a very bitter fight in Congress. So, a stalemate looms.

▸ **Synthetics.** Interior Department is polishing up a proposed bill to push development of a commercial synthetic fuel industry in the U. S. Like the Wolverton bill of last session, Interior's bill would provide for RFC loans to finance private plants or build government plants, if industry were not interested. But the new bill would give the Bureau of Mines more authority in the program. First stage would be to build three plants of 10,000 bbl a day each, one for coal hydrogenation, one using the Fischer-Tropsch process for coal and a third plant for oil shale at a total cost of not over $250,000,000.



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Like those of other industries and businesses, oil men are trying to stall off decisions until they see which way the Administration will move. Sinclair joined Phillips in the 35-cent crude oil price advance and other smaller buyers followed suit. Uncertainty of coming trends are seen in various actions taken on products prices, some going up, others down in price. Both crude oil and production in western Canada were reduced in price. Crude oil was cut to $3.09 for 33 deg in Turner Valley.

Not only is the industry disagreeing on the immediate effects of a price increase but completely opposite views of secondary and tertiary results are expressed. The best development so far is the demonstration of competition that is so much more effective than telling the public it is so.

The program to enlighten the American public on the organization and achievements of the oil industry is at last showing some mark of cumulative effect. The man who hears once or twice about the progress of the industry may forget, but the one who sees an advertisement, hears a radio broadcast, reads about a special Oil Progress Day, and hears the Kiwanis luncheon speaker on the subject begins to have an idea of what the oil industry is about. The Oil Industry Information Committee states awareness is highest among men, adults, highly educated people, and those in medium-size cities. These conditions are not, however, prerequisites for good customers and potential well-wishers. The oil industry would reach more groups by adopting a Shmoo appeal.

Demand for butane and propane gas has built a tremendous arm to the petroleum industry. Last winter some consumers suffered from shortages as a result of inadequate storage and distribution facilities. Production is high enough at present to meet demands and installation of more storage facilities improves the outlook for this winter. It may be a close squeeze if weather is unusually cold and consumers are urged to keep tanks filled to supplement commercial shortage. As the whole industry has had to prove its responsibility to the public for supplying products, this branch of the industry must accept its responsibility or face further regulation.

China will get $14 million of crude oil and petroleum products allotted by U. S. foreign aid program November 11. Again on November 24 shipments of $22,000,000 worth of oil from Saudi Arabia to China were authorized. Also $26,400,000 worth of crude oil and products from the U. S. was alloted Great Britain.

New Venezuelan government, rising last month when the army took over with scarcely a shot, reassured oil companies. Foreign investments, Minister of Development Pedro Ignacio Acuerrevere stated, would be "safe and sound." The new administration will adopt a friendly attitude toward the oil industry, he said.

Max M. Ball, who retired December 1 as director of the Oil and Gas Division, Department of Interior, (Page 45) thinks the agency should grow in "importance, usefulness, and effectiveness." Max Ball has made the most of a difficult job. The oil industry and the government were fortunate in having a man of his wide knowledge and good judgment to head the coordinating body for two years.

Congress will be asked for $400,000 to run the division next year, the same amount asked last year when $275,000 was approved. The new Congress is expected to be more liberal.

Middle East oil development took another step forward when agreement was reached whereby Standard Jersey and Socony-Vacuum bought into the Arabian-American Oil Company, formerly owned 50-50 by Texas and Standard California. Some $100,000,000 changed hands in the deal. Never has development of oil reserves involved so many political complications as are presented by the Middle East. There is a tendency on the part of many to regard Middle East oil as the crux of the Communistic-Democratic struggle but it is actually incidental. The only withdrawal by the Soviet was from Iran but other countries with oil reserves have not been so fortunate.

Present trends in government control of the nation's economic system will bring private enterprise to a standstill, a Brookings Institution survey warns. Control that involves the assumption of managerial functions must be clearly avoided if private enterprise is to continue as the economic organization of the United States, according to the study. The attitude toward business and industry by the government in recent years leads to the conclusion that it will be largely up to private enterprise to save itself if it is to be saved.

Some $800,000,000 will be asked from Congress by the Department of Interior to start a synthetic gasoline and oil industry, it was learned recently.

This would be the first installment on a program designed to build enough commercial plants to overcome a fuel shortage in event of war. Its total cost is now estimated at $12,000,000,000.

A bill was introduced in the last congress to grant $350,000,000 as the first step of a $9,000,000,000 program but was not passed.

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Since the dawn of printing editorial writers have lavishly handed out reports and opinions with scarcely a rebuff from the silent reader until modern editors discovered readers were as interested in what other subscribers said as in what the editorial writer expounded.

A large proportion of *The Petroleum Engineer's* editorial content has always been written by engineers, who could be classified as subscribers. To make it easier, however, for readers who have only a few lines to say and not a whole article, a new column, "Letters to the Editor," will begin next month.

You are invited to make any comment in general or in particular about what you find in *The Petroleum Engineer* or what you think you should find there and don't. Whether your opinion is favorable or not, you have your space to say what you will. You may be able to supplement findings discussed in an article or you may have new questions about some point. Direct your correspondence to "Letters to the Editor."

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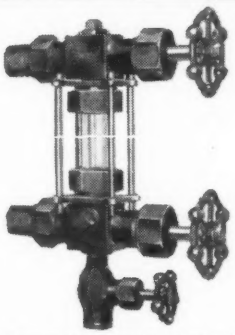

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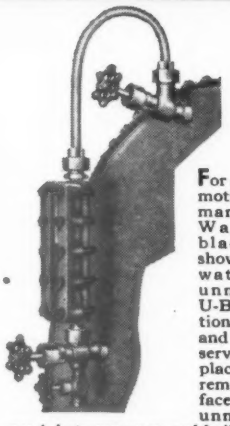

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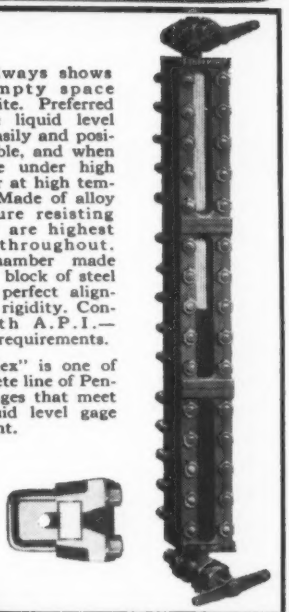

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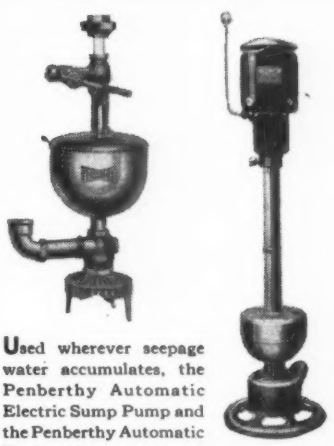

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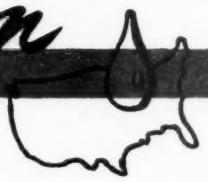
national petroleum situation



By H. J. STRUTH*,
Petroleum Economist

▸ **Supply-Demand Picture.** The petroleum demand outlook for 1949 indicates a continued climb to new high levels, but the rate of increase will be somewhat slower. Domestic demand may increase next year by about 6.2 per cent, compared with this year's gain of 7.4 per cent. Demand for motor fuel is likely to increase in 1949 by 5.2 per cent, compared with 7.7 per cent this year. Higher prices for products and slackening industrial activity are factors considered in this forecast. This is how the supply and demand picture looks to the writer:

*Editor, *The Petroleum Data Book.*

(Thous. bbl daily)	Supply		Demand		Stock-Change
	Domestic	Imports	Domestic	Exports	
1947	5,449	437	5,449	451	— 14
1948	5,885	495	5,850	380	+150
1949	6,105	565	6,210	350	+110

▸ **Price Anomaly.** Decision of Sinclair to meet Phillips' price, coupled with announcement of Imperial of Canada reducing crude prices up to 52 cents per bbl and lowering gasoline prices 2¼ cents per gallon, leaves the crude market outlook in a confused state. Posting of reduced prices for U. S. heavy fuel oils and shading of distillate prices in eastern markets indicate continued opposition to higher crude prices. Crude stocks are increasing and inventories of all oils are 86,000,000 bbl above last year. Economic factors apparently do not favor higher crude prices; well connection losses may not be the decisive factor.

▸ **Distillates Plentiful.** Demand for distillate fuel oils this winter is placed at 1,342,000 bbl daily, compared with 1,194,000 bbl daily last winter. Prospective increase is 12.4 per cent. Yet, stocks of distillates next March 31 may total about 41,000,000 bbl. This would be an increase over last winter's carry-over of 9,000,000 bbl.

▸ **New Drilling Peak.** An all-time peak for drilling will be recorded this year. Total wells drilled will be about 38,800, compared with 33,300 drilled in 1947. Exclusive of service wells, the total this year will be about 36,725, against 31,026 in 1947. The greatest number of wells drilled previously was 33,911 during the year 1920.

Comparative Statistics, November, 1948

*All figures are computed on a Bureau of Mines' Basis**

	Nov. 1948℗	October 1948℗	Nov. 1947	This year to date	Last year to date	Per cent change
Wells drilling	4,950	¶5,040	4,520	4,950	4,520	+10
Total wells drilled	3,412	3,616	3,036	35,299	30,415	+16
Development wells	2,707	2,813	2,318	27,679	23,635	+17
Oil	1,874	1,922	1,515	19,161	15,781	+21
Gas	223	260	277	2,348	2,938	—20
Dry	612	631	526	6,170	4,916	+26
Per cent dry	22.6	22.4	22.7	22.3	20.8	+ 1.5
Service wells	163	170	243	1,888	2,051	— 8
Wildcat wells	540	627	475	5,732	4,729	+21
Oil	82	86	66	875	744	+18
Gas	15	21	18	230	188	+22
Dry	443	520	391	4,627	3,797	+22
Per cent dry	82.0	82.9	82.3	80.7	80.3	+ 0.4
Crude supply*	181,880	184,600	166,424	1,950,661	1,779,384	+10
Daily average	6,062	5,955	5,547	5,823	5,327	
Crude demand‡	177,700	181,900	167,280	1,937,133	1,778,475	+ 9
Daily average	5,923	5,868	5,576	5,782	5,325	
Crude stocks	244,180	¶240,000	231,085	244,180	231,085	+ 6
Days supply	41	41	41	41	41	
Natural gasoline production	11,550	12,000	11,901	129,888	119,693	+ 9
Daily average	385	387	397	388	358	
Motor fuel production	76,500	78,900	72,061	836,102	764,746	+ 9
Daily average	2,550	2,545	2,402	2,496	2,290	
Gasoline yield, per cent	40.0	40.6	40.1	40.1	40.2	— 0.1
Motor fuel demand‡	73,500	77,100	68,075	830,240	771,562	+ 8
Daily average	2,450	2,487	2,269	2,478	2,310	
Motor fuel stocks△	93,000	90,000	82,985	93,000	82,935	+12
Days supply	38	36	37	38	37	
Fuel oil production	71,800	71,750	65,598	772,578	689,463	+12
Daily average	2,393	2,315	2,187	2,306	2,064	
Fuel oil demand‡	72,000	69,000	75,014	786,063	762,891	+ 3
Daily average	2,400	2,226	2,500	2,346	2,284	
Fuel oil stocks	161,050	154,250	113,789	161,050	113,789	+42
Days supply	67	69	46	67	46	
Refinery still runs	170,500	173,000	158,719	1,853,240	1,686,388	+10
Daily average	5,683	5,581	5,291	5,532	5,049	
All refined stocks	358,100	¶344,980	284,994	358,100	284,994	+26
Days supply	60	59	48	60	48	

Supply and Demand—All Oils

	Nov. 1948℗	October 1948℗	Nov. 1947	This year to date	Last year to date	Per cent change
Total supply, all oils	198,660	201,400	184,006	2,135,588	1,955,654	+ 9
Daily average	6,621	6,497	6,134	6,375	5,855	
Total demand‡, all oils	181,360	184,300	182,168	2,034,104	1,946,669	+ 5
Daily average	6,045	5,945	6,072	6,072	5,828	
Change in stocks	+17,300	+17,100	+1,838	+101,484	+8,985	

Current Crude Oil Prices

U. S. average	$2.61	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.63	Mississippi	2.42
Kansas	2.62	Illinois	2.76
		Other states	3.15

Basic crude prices:

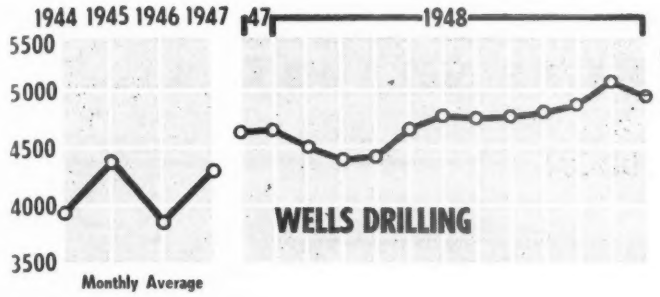
Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.86
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.41
Pennsylvania, Bradford	5.00

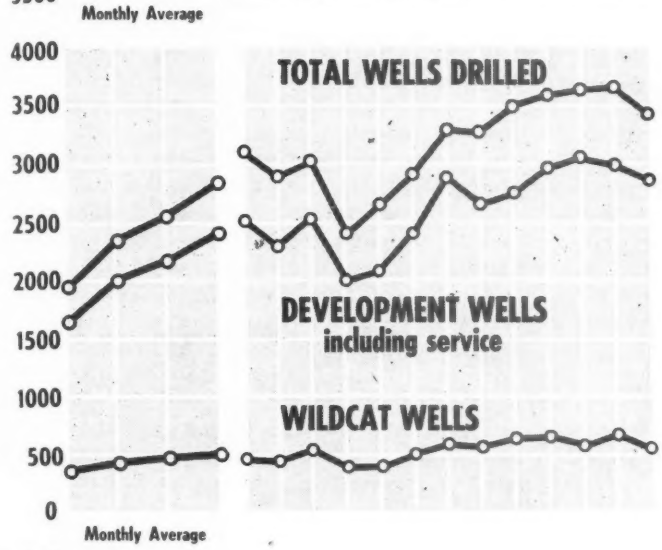
Drilling and Production Statistics by States

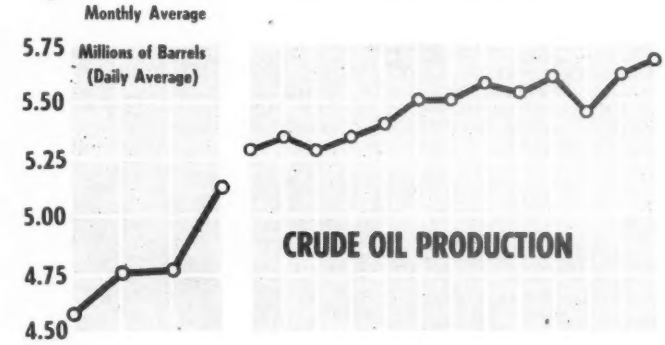
	Nov. 1948℗	October 1948℗	Nov. 1947	This year to date	Last year to date	Per cent change
Wells drilled (excl service)	3,249	3,440	2,793	33,411	28,364	+18
Arkansas	22	33	41	282	306	— 8
California	241	239	179	2,614	1,837	+42
Illinois	222	269	182	2,230	1,863	+20
Kansas	278	309	250	2,858	2,386	+20
Louisiana	176	222	180	2,095	1,505	+39
Mississippi	33	38	35	376	451	—17
New Mexico	46	50	44	542	501	+ 8
Oklahoma	384	400	279	3,830	3,488	+10
Texas	1,083	1,105	808	11,027	8,538	+29
Other states	764	775	795	7,557	7,489	+ 1
Wildcats drilled (incl above)	540	627	475	5,732	4,729	+21
Arkansas	9	9	7	92	65	+42
California	45	58	23	439	311	+41
Illinois	31	53	49	395	409	— 3
Kansas	51	63	32	483	368	+31
Louisiana	23	31	31	272	267	+ 2
Mississippi	7	12	7	95	87	+ 9
New Mexico	7	7	5	58	45	+29
Oklahoma	61	73	68	746	776	— 4
Texas	202	225	171	2,300	1,706	+35
Other states	104	96	82	852	695	+23
Daily crude production	5,679	5,620	5,291	5,492	5,062	+ 8
Arkansas	86	86	85	86	82	+ 5
California	963	933	930	928	911	+ 2
Illinois	181	181	175	177	182	— 3
Kansas	291	302	295	300	288	+ 4
Louisiana	508	497	466	492	436	+13
Mississippi	131	129	108	125	95	+32
New Mexico	135	133	121	130	112	+16
Oklahoma	442	433	401	419	384	+ 9
Texas	2,546	2,527	2,359	2,460	2,233	+10
Wyoming	158	161	132	149	120	+24
Other states	238	238	219	226	219	+ 3

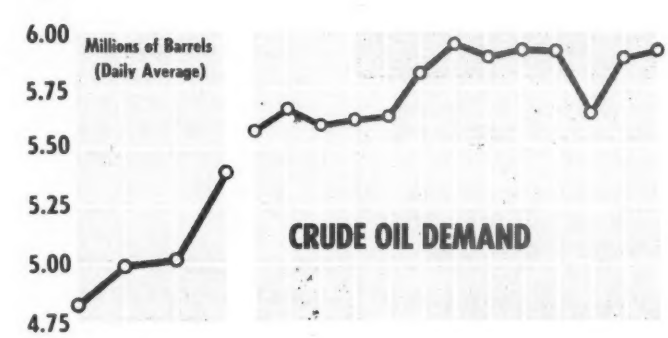
*Unless otherwise stated all figures represent thousands of barrels. ℗–Preliminary. *Includes domestic production and imports.
‡Total demand, including exports. △Includes finished and natural gasoline. ¶Revised.

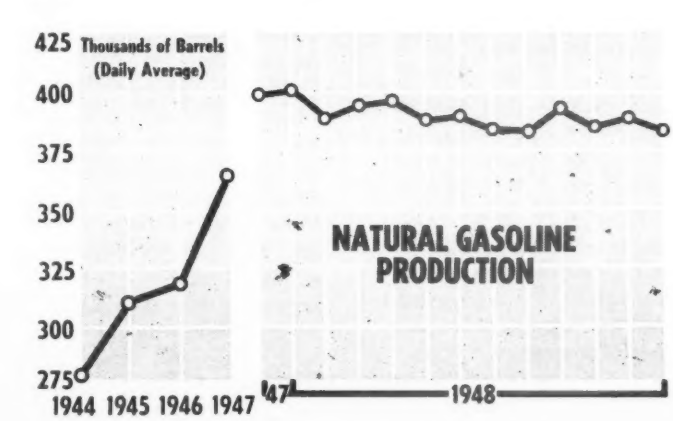
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

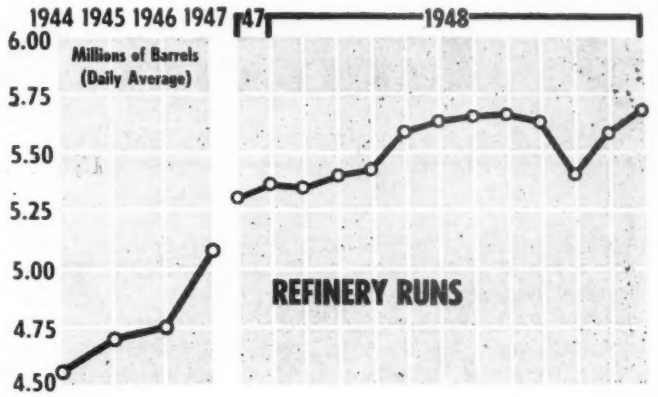


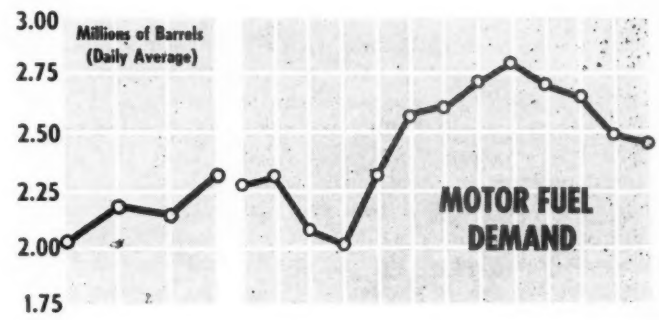


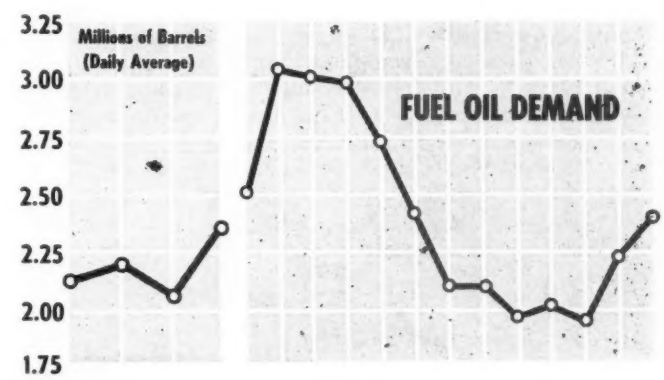


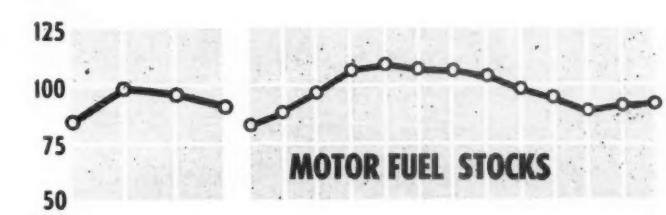


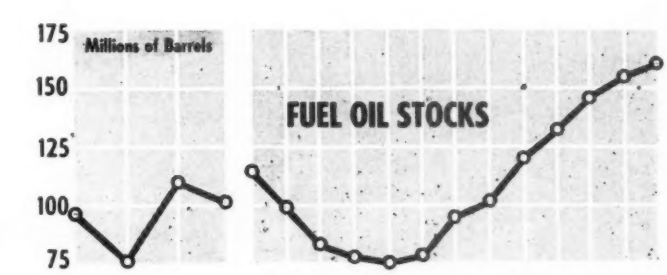












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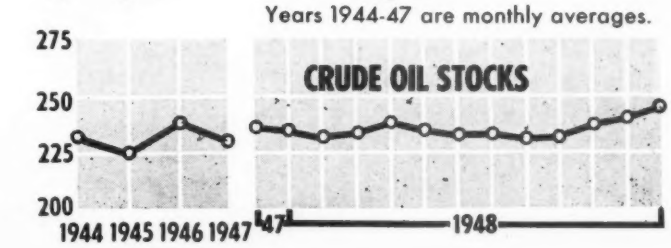

PETROLIC PERSONALITIES

DICK SNEDDON

LATE IN 1923, we debarked from the good ship *H.F. Alexander* at Wilmington, California, and soon thereafter became a distinctly minor member of Union Oil Company's research staff. Being at that time still possessed of energy, ambition, and a modest concentration of rather pale hemoglobin, for the first month or so of our new employment, we wrenched the petroleum hydrocarbons apart with great zeal, carefully examined their fractured bonds, and in general comported ourself with beaverish eagerness. One of our first American buddies was Jack Ivy, now the laboratory storekeeper, a cheerful Texan who was then always located at the far end of a monstrous cigar, and looked as if he were hanging by his teeth from a junior zepplin. Another lad with whom we consorted early was Al Bly, from Des Moines, Iowa, now in Richfield Oil Corporation's refining department, and as quiet as Jack was demonstrative. These two inseparable pals toted us into Los Angeles in Al's new Buick for our first gander at the big city. As we drove along one of the main streets, we pointed to a huge structure that seemed to pierce the sky, and asked, "What building is that, Jack?" Rolling his cigar over to the other side, he took a casual squint and said, "Don't know—it wasn't there last night." A short time later we moved into Huntington Park, and being a good Presbyterian, looked around on Saturday night for a church. There was none in H.P. but we located one in South Gate a short distance away. On Sunday morning, accompanied by the family, we drove down to the 11 a.m. service. But there wasn't any. Someone had moved the church during the night, and we have never seen it since. Amazing, we thought, how these Americans can put 'em up and tear 'em down.

BILL MORRISON, the Tulsa pipe liner, tells us that in some parts of West Texas, gas line leaks are detected in most unusual ways. In these areas, untreated gas is so odoriferous that when a line leak occurs, the coyotes gather in the vicinity and start digging for what they think is a dead body of an early vintage. Vultures are similarly intrigued by the prospect of a meal, and hover insistently over the spot. Bill says that the line walkers are duly grateful for this unwitting tipoff service. Speaking of vultures, incidentally, we once knew a vulture—but, shucks, this is no place to indulge personal spleen, so let's get back to the record. Bill Vietti, chief petroleum engineer of the Texas Company at Houston, is a graduate of University of California, and in his spare time is also an accomplished lapidary (Aw—look it up for yourself!). But what we really want to tell about Bill is that although very much alive at the moment, he was once quite dead for five hours, or so he claims. The story goes that in his early days around the sour oil fields of West Texas, he and a buddy decided to go down below the floor of the derrick they were working on to recover a wedge out of a rod hanger that had dropped into the cellar, the idea being to save a trip to the warehouse in town. While tramping about in the mud looking for the wedge, Bill was overcome by the sulphur gas, and the other fellow was just barely able to scramble out, give one horrified yell, and then collapsed. A worker ran up and pulled him clear, but could see no one else when he peered down into the cellar. At that moment, however, a little fellow came along, and sizing up the situation, decided he had better go down below and take a look. He did, and found Bill Vietti almost completely submerged in the mud, and unconscious. He managed to prop the victim up with his head above the ooze, before he, himself, had to dash up on deck for air. By this time others had arrived, and they hauled Bill out and gave him artificial respiration. Five hours later he regained consciousness. But he never saw that little fellow who saved his life, and to this day doesn't know who he is, although he would sure like to. If you can tip him off as to the identity of his benefactor, Bill will be grateful no end. And we guess he will cut that lad a right nice stone in acknowledgement of his indebtedness.

WE STOOD BESIDE LUDWIG KNIEL, the Lummus Company biggie from New York, at the Ambassador Hotel swimming pool, Los Angeles, while Dorothy Poynton and Johnny Riley, erstwhile Olympic diving champs, went through their dunking paces, and it was an exhilarating experience to note his appreciation of their talent. And they are really marvelous—Johnny can do a 2½ gaynor or something off the 36-foot diving board on to a damp rag. And as for Wes "Bubbles" Hammond, with his comedy swimming strokes and zany diving antics, it is a long time since we have seen a group of oil men so thoroughly entertained. R. D. "Frick" Gibbs, Union Oil Company vice president, and himself an excellent swimmer, seemed to be getting a big bang out of the show. And, perhaps even at the risk of repeating we should recall one of his own famed comedy stunts. Frick, be it known, was one of the best all-around athletes in the oil industry for many

1. *The Petroleum Engineer*—All Divisions. This will include all sections and will be like this issue of the magazine.

2. *The Petroleum Engineer Exploration, Drilling, and Production Magazine*, which will include the first two sections. (In this issue the sections cover Pages 1 to 188).

3. *The Petroleum Engineer Refining and Natural Gas Processing Magazine*, which will include the General Section (Pages 1 to 110 in this issue) and the Refining and Gas Processing section (Pages 189 to 238 in this issue).

4. *The Petroleum Engineer Pipe Line and Marine Transportation Magazine*, which will include the General Section (Pages 1-110) and the Pipe Line and Marine Transportation Section (Pages 239 to 276 in this issue).

Of the subscribers who have already indicated their choice, 70 per cent have preferred one of the three specialized magazines. If you have not selected which of the four you want, use the subscription card in this issue to indicate your preference.

years. He was a champ tennis player, golfer, hand ball player, and, in fact, he was just a sports natural. Anyway, one year he won the golf championship of the California Natural Gasoline Association, and after the tournament with all the trimmings was over, he took off for home in the wee sma hours, with a cup tucked under his arm. It was one of these perpetual trophies, and had inscribed on it the names of all the CNGA champs back to the year of the great flood. Arriving home, he found the place in darkness and so he tiptoed quietly around to the back door. Setting the cup on the doorstep, he searched for his key, and then opened the door, knocking the trophy off the step. When he picked it up he found that one of the arms was broken off, but being something of a mechanic, wasn't too much disturbed. Once in the kitchen he lit a burner on the stove and held the two broken pieces in the flame, intending to weld them together. Suddenly, to his dismay, the whole business melted and ran under the stove. For the next few weeks Frick was the busiest man in town, first locating a duplicate of the CNGA golf trophy, and next having it engraved with a list of winners that looked like the Los Angeles city directory.

By way of a last minute round-up we note that Charlie Potter is back in Bogota after an enjoyable but strenuous vacation in the U. S. He sends his regards to all the folk who helped make his stay so pleasant, and would like to have it known that after a few months of work, he is sure he will be fully recovered from the vacation. A letter from Ed Swanson, Bureau of Mines, Washington, who is interested in everything and anything pertaining to the history of petroleum. He already has a fine library of oil literature and adds to it at every opportunity. He was especially pleased, and so were thousands of western oil men, with the excellent work, "California's Oil," prepared by Ted Sutter for the Petroleum Production Pioneers, and published by the API under the direction of R. E. "Bob" Allen. Bob really turned out a grand job and his stock has mounted high on the western ticker. After spending a Saturday morning on the links at the Wichita, Kansas, Country Club, with Bob Smith of Cardwell Manufacturing Co., Floyd Morgan, the P. E. advertising rep, is looking for a pro to straighten out his swing, or an accountant to straighten out his bank balance. Floyd says, "Drives are for show and putts are for dough," and when you meet a chap like Captain Bob Smith, who is good at both, discretion is much the better part of valor. It is our personal opinion, in case anyone cares, that when a man starts digging oversize divots, he is bending his elbow, which he shouldn't do until he reaches the 19th hole.

Concluding: When Jim Moon, the lad who taught Izaak Walton how to fish, returned recently from an extended safari into the effete East—of the U. S., that is—he was met at the Los Angeles airport by the Waldrip Warblers, a newly organized musical agglutination of great promise. (They. have promised not to do it again unless provoked.) Anyway, this cultured coterie, consisting of Mrs. Moon, Mrs. Ew Wagner and Ed, and Bill Sprague, were on hand when the plane came in, and they carried a strange assortment of musical? instruments. Bill laid a strip of carpet on the passenger runway, and then skillfully handled the baton while the orchestra tootled the prodigal back into town with an astonishing version of that classic ballad, "When Moon Comes Over the Mountain." The cause of this jubilant outburst immediately recognized the piece, despite the way it was being abused, and now the musicians are so stuck on themselves they have applied to Petrillo for a permit to apply to Petrillo for a permit, if you know what we mean.

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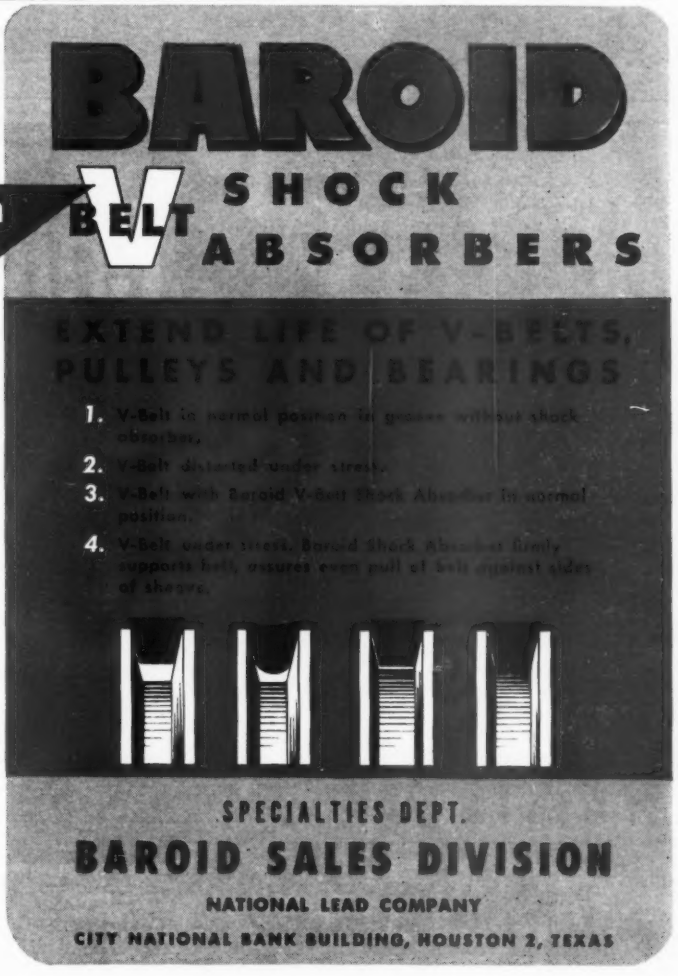

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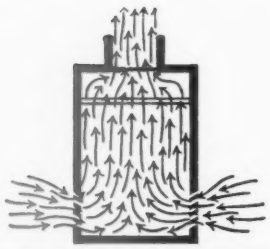

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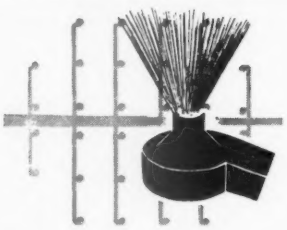

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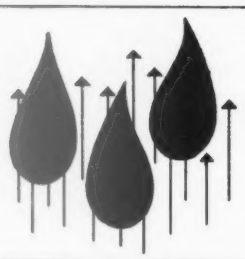

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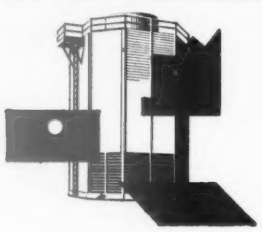

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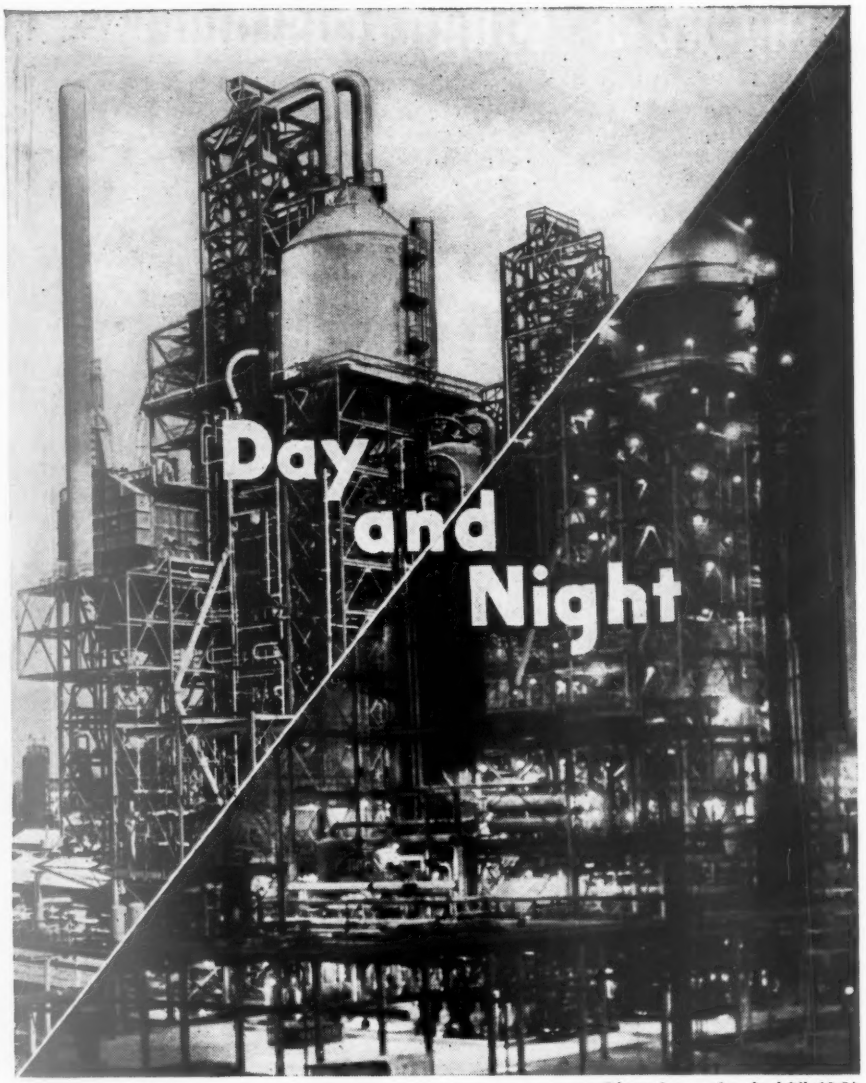

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MEETINGS

Jan. 10-14—SAE, annual meeting, Book-Cadillac Hotel, Detroit, Michigan.
Feb. 9—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.
Feb. 14-17—AIME, annual meeting, San Francisco, California.
Feb. 28-Mar. 4—ASTM, spring meeting, Hotel Edgewater Beach, Chicago, Illinois.
Mar. 6-10—American Institute of Chemical Engineers, Los Angeles, California.
Mar. 7-10—NACE, annual meeting, Cincinnati, Ohio.
Mar. 9—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.
Mar. 9-10-11—API, Southwestern District meeting, Galvez Hotel, Galveston, Texas.
Mar. 17-18—Oklahoma Utilities Assn, Hotel Tulsa, Tulsa, Oklahoma.
Mar. 23-25—API, Mid-Continent District meeting, Mayo Hotel, Tulsa, Oklahoma.
Mar. 27-April 1—ACS, spring meeting, San Francisco, California.
Mar. 28-30—Western Petroleum Refiners Assn, annual meeting, Plaza Hotel, San Antonio, Texas.
Mar. 28-30—SAE, Transportation meeting, Statler Hotel, Cleveland, Ohio.
Apr. 11-13—American Society of Lubrication Engineers, annual meeting, Pennsylvania Hotel, New York.
Apr. 11-13—Mid-West Gas Association, 44th annual convention, Hotel Ford, Des Moines, Iowa.
Apr. 11-13—National Assn of Corrosion Engineers, Netherlands Plaza Hotel, Cincinnati, Ohio.
Apr. 11-15—Western Metal Congress and Exposition, Shrine Auditorium, Los Angeles, California.
Apr. 12-14—Southwestern Gas Measurement Short Course, O. U., Norman, Okla.
Apr. 12-14—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.
Apr. 13—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.
Apr. 13-14-15—National Petroleum Assn, Hotel Cleveland, Cleveland, Ohio.
Apr. 18-20—Mid-West Power Conference, Hotel Sherman, Chicago, Illinois.
Apr. 20-22—Natural Gas Assn, annual meeting, Texas Hotel, Fort Worth, Texas.
Apr. 27-28-29—API, Eastern District meeting, William Penn Hotel, Pittsburgh, Pa.
May 2-4—ASME, spring meeting, New London, Connecticut.
May 2-4—Independent Petroleum Assn of America, mid-year director's meeting, New Orleans, Louisiana.
May 8-10—American Institute of Chemical Engineers, Tulsa, Oklahoma.
May 9-10—American Gas Association, spring meeting, French Lick Springs Hotel, French Lick, Indiana.
May 11—Institute of Petroleum, Manson House, 26, Portland, London, W. 1.
May 12-13—API, Pacific Coast District meeting, Biltmore Hotel, Los Angeles, Calif.
May 26-27—API, Rocky Mountain District meeting, Gladstone Hotel, Casper, Wyo.
May 26-27—The Natural Gas and Petroleum Assn of Canada, annual meeting, Hotel London, London, Ontario.
June 6-11—SAE, summer meeting, French Lick Springs Hotel, French Lick, Indiana.
June 13-14—Institution of Gas Engineers, annual meeting, London.
June 15-17—International Gas Conference, International Gas Union, London.
June 27-July 1—American Society for Testing Materials, annual meeting, Hotel Chalfonte-Haddon Hall, Atlantic City.

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THE Petroleum Engineer

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History and Analysis of Bureau of Mines' Petroleum and Natural Gas Division

By ERNESTINE ADAMS*

PART 1. Influence of the Work of One Federal Branch Upon the Oil Industry, Other Government Agencies, and the Public

THE work of the Petroleum and Natural Gas Division† of the U. S. Bureau of Mines reaches into far places and many happenings in modern life. Few persons realize what this small body of scientists and engineers does.

A man is wheeled into the operating room and stretched upon the table surrounded by white masks under intent eyes. The anesthetic equipment is rolled close and the job of saving another life has begun. The man who breathes the anesthetic has a better chance of enduring the operation because of the production of helium, one of the Division's projects.

A motorist drives up to a service station and says "Fill 'er up" without a thought about whether the particular fuel in the tank will run the engine of his particular car or ruin it. He can buy gasoline anywhere in the United States, in village or city, North or South, knowing it is safe and efficient for his purpose. American refiners tailormake gasoline for American motors with the aid of the Division, which keeps a record of gasoline quality. To make good motor fuel the oil industry needs a constant check on characteristics and performance.

EXCLUSIVE

The Royal Air Force had received long-distance aid from the Division when Churchill said: "Never in the field of human conflict was so much owed by so many to so few." The new fuel that powered the RAF planes was available because the agency was able to give early information about U. S. oil fields that produced the type of crude oil suitable for aviation gasoline.

Outside the oil and gas industry and some government agencies, very few have any idea of the contributions to their well being that come from the Petroleum and Natural Gas Division.

The petroleum industry knows that the agency is in there doing some steady pitching, but it is only vaguely conscious of how much the infielders and outfielders depend on the tireless throwing from the mound.

The operator in Pennsylvania who was shown by Bureau men that he had not drilled to the best sand, knows that they are spreading the use of electric logging of wells and diagnosis of wells by this method. The president of a gas utility company in Texas knows that the back pressure test of gas wells developed by the Division has guided engineers in operating the firm's gas wells. A refinery manager in Kansas knows that a Bureau chemist demonstrated how wax could be processed at a profit from a lake of oil waste.

▸ **Present set-up.** The number on the agency's staff has always been small. The technical personnel reached a total of only 147 at the height of its expansion for war work in 1945. At the headquarters in Washington, D.C., are the Chief of the Division, R. A. Cattell; his assistant, C. C. Anderson, who is also Chief of the Petroleum

*Managing Editor, *The Petroleum Engineer*.

†As of January 1, 1948, the designation of this unit was changed from "Petroleum and Natural Gas Division" to "Petroleum and Natural Gas Branch." In this article the former designation is used as it is more familiar to readers.

Subdivision, and H. S. Kennedy, Chief of the Helium Subdivision in charge of helium work and related natural gas activities. These are the administrative officers of the Division who are assisted by C. L. Moore, senior petroleum engineer and R. M. Gooding, senior petroleum chemist.

In Bartlesville, Oklahoma, and Laramie, Wyoming, are experiment stations. H. C. Fowler heads the Bartlesville Station, which has a staff of 75 technical men and women. H. P. Rue is in charge of the Laramie staff of 19. The Dallas, Texas, office, whence come the important Gulf Coast engineering studies, was headed by H. B. Hill, retired in June '48, and now is directed by C. B. Carpenter with a staff of 6 in Dallas and 2 in Wichita Falls. The laboratory and field office at San Francisco, California, is under H. C. Miller, who works with 6 engineers and at the Franklin, Pennsylvania, laboratory and field office Sam S. Taylor is in charge of a staff of 11. The Amarillo, Texas, helium headquarters are under C. W. Seibel, with a staff of 17 technical men.

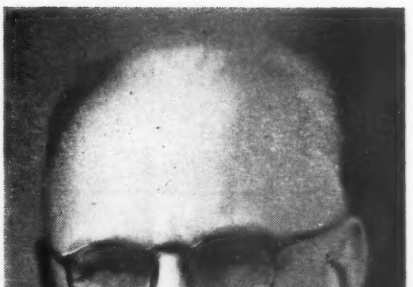
The physical properties of the Division are decentralized to be close to actual operations. The work on a project is well coordinated so that, if necessary, two or more stations can aid in reaching a conclusion.

The work of the Petroleum and Natural Gas Division is so technical and so far reaching that it is not too well understood even by those who benefit directly from its findings. Many have an idea that it has law enforcement duties and these generally amplify the statement with the comment that Bureau men are very nice about enforcing regulations.

Relation with operators. As a matter of record the Division has no power to make or enforce any rules whatever. It has the job of developing and carrying out any research pertaining to oil and gas and supplying the information gained to anyone who can use it.

None of its staff has ever said to an operator, "You must drill your well this way because we tell you to." Bureau technologists exchange ideas on improved methods with men in the industry, test theories with research, and spread the gospel of good practices by demonstration. That is all. This propitious method has a long and honorable history in the United States. The great Baron von Steuben, who was brought from Prussia to train the ragged troops at Valley Forge, wrote to a kinsman:

"You say to your soldier, 'Do this' and he does it. But I am obliged to say to the American, 'This is why you ought to do that,' and then he does it."*



***R. A. Cattell,** capable Chief of the Petroleum and Natural Gas Branch, Bureau of Mines, has been associated with the Bureau in various posts for more than 30 years. He began in 1917 when he was made oil and gas inspector, Bureau of Mines, at Muskogee, Oklahoma. Cattell then took a year off to serve with the U. S. Army from 1918-1919. At the end of the war he did not return home immediately, but spent another year as petroleum engineer with S. Pearson and Son in Chesterfield, England, and Societe d'Etudes des Recherches et d'Exploitation de Petroles in Algerie at St. Aime, Algeria.*

In 1921 Cattell became petroleum engineer for the Bureau at Dallas, Texas, and Shreveport, Louisiana. He advaneed rapidly during the next few years going to Bartlesville, Oklahoma, first as natural gas engineer, later as assistant superintendent and superintendent.

He was made chief, Helium Division, Bureau of Mines, Washington, D. C., in July 1925 and continued in that position until 1933, when he took over the job he now holds. His list of duties is impressive, including charge of Bureau of Mines technologic research on petroleum, natural gas, helium, and oil shale; acquirement and development of helium-bearing natural gas properties; construction and operation of helium plants to supply all governmental and private demands. Added to this is his responsibility in the construction and operation of an oil shale demonstration plant.

A native Iowan, Cattell received his B.S. in Civil Engineering from the University of California.

The Petroleum and Natural Gas Division has never had any power other than the knowledge gained from research and experiment and it has used this to influence the industry toward more advanced methods of operation. In actual practice much of this knowledge has been obtained from the oil industry and equipment manufacturers, who carry on a ceaseless search for better methods and better tools. The results are gathered and passed on from one part of the country to the other. The Division as a catalyst for ideas from industry, has been more important than it has been as the originator. Indispensable to its mission is the distribution of information.

Especially in the early days of its existence, when a scientific approach to petroleum problems was looked upon with some scorn by practical men, did the technologists of the Bureau explain, "This is why you ought to do that." Today information from the Division is greeted with respect but its staff still uses the same approach, which is doubtless one of the important reasons why its ideas are readily accepted and widely used.

One oil operator put it succinctly, "I do not regard it as a government bureau," and went on to say "It is an established agency doing an excellent job with trained men who are not unduly influenced one way or the other."

The Division certainly does not act like a government bureau as most of the individualistic members of the oil industry would describe one. It is more like a good research department set up by the people for accurate, unbiased information on petroleum—which, of course, is what it is.

Why government research. There are some who might question the need of a government division devoted to petroleum research when most large companies and some smaller ones have research departments of their own and some concerns have been organized solely for the purpose of research in the industry.

When we go back into the history of the government's interest in petroleum research and the establishment of the Petroleum and Natural Gas Division in 1914, we shall find that the development of scientific research by the oil industry was fostered by the early technologists of the Bureau who showed that material benefits can be gained from the application of scientific truths. These men played a vital

*From Winter Prairie Schooner, 1947, The University of Nebraska Press.

part in stimulating fundamental investigation that led to modern methods of operation and greater conservation of our oil and gas resources.

In present times the Division acts as the research department of thousands of small companies, which do not have the personnel, equipment, or funds to support their own departments. The field operators can get information about technical problems in drilling and production in the particular areas in which they are interested. The refiners can learn from the Bureau the most efficient processing for the specified crude oils that they are running. The pipe liners can obtain data on corrosion and other problems they encounter. The terminal men can find out the best methods of combating evaporation.

The Division also is important to large petroleum companies, even though one organization may spend many times as much on research as the amount appropriated by the Congress for the government oil and gas research division.

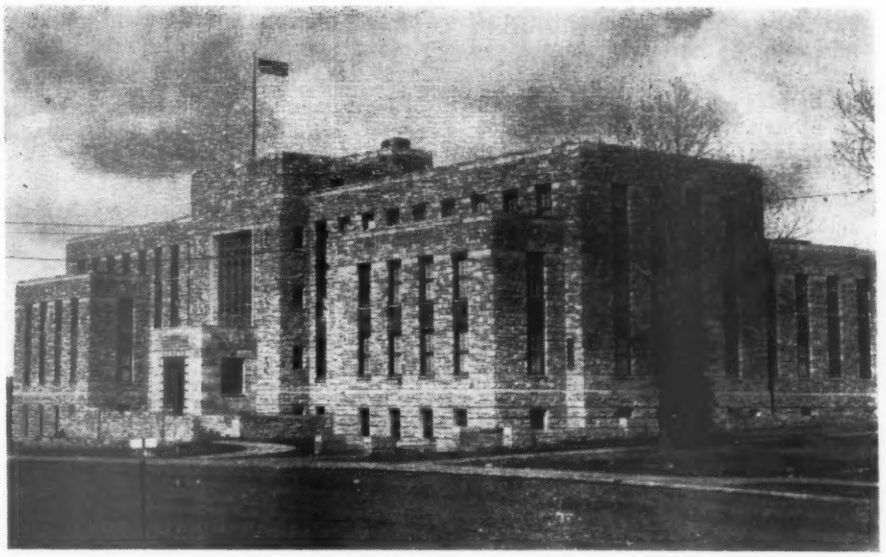
It must be understood that the body concerns itself primarily with research on basic problems that are not generally covered by industrial laboratories. These projects may not be directly beneficial to a business or their benefit may not be clearly seen. The object of the Division is to show how operations that conserve petroleum resources can be profitable.

Secondary recovery research is a good example of the Division's sphere. One purpose of this particular project is to learn how abandoned oil fields can be opened again by secondary recovery methods and more oil extracted economically. Some companies are working on the same project on their own leases but the Division's object is to show what programs are feasible over greater areas and by small operators or groups of operators.

Division men combine and develop methods already in use and experiment with others they have conceived. In their freedom to gather material from border to border in the nation they have a unique opportunity to study every practice in use and are exceptional judges of the worth of new technical innovations. They are never in competition with private industry and are quick to drop any project that the industry is carrying along satisfactorily on its own.

In collecting information from private organizations all over the country, the Division staff has an unbroken record for keeping those facts that are strictly confidential. It is a relief in these days when keyhole artists and congressional probes throw so many broken confidences into the limelight to hear one oil company after another say that it opens its private files to Bureau men because it has found them consistently trustworthy.

A comment on this that can be gone into more thoroughly later is that the Division has greatly influenced the petroleum industry in its policy of openly exchanging information that was once heavily guarded. There are few—if any—industries in which companies are so liberal in giving details of discoveries that have cost them large sums to learn.



The Bureau of Mines Petroleum and Oil-Shale Experiment Station, Laramie, Wyoming, is the latest and most modern building in the Division. It houses a technical staff of 19 members on petroleum research and some 100 employees, technical and administrative, on oil-shale research under direction of an highly experienced engineer, H. P. Rue. The laboratory is one of the best equipped in the nation, including the only mass spectrometer in the region.

In these days when the Federal government looks askance at industry and industry views the Administration with some misgiving, the 34-year-old co-operative effort of one Federal branch and the oil industry provides a reason for renewed confidence. The government, the industry, and, most of all, the public, have benefited from the quiet research and unobtrusive liaison work of the Petroleum and Natural Gas Division synchronized with the dynamic progress of the industry. Here is a tried and trusted basis for government-industry cooperation, one that costs little and gives much. It is an example worthy of closer study by those who organize government and those who lay the course of business and industry.

▸ **Government adviser.** Not only is the Petroleum and Natural Gas Division an overall research department for the industry, it is an adviser to the U. S. government on petroleum—a position that no politically appointed bureau can fill, although in time of war it has sometimes been pushed into the job of errand boy.

In 1942, the then Secretary of the Interior, Harold L. Ickes, said; "The first thing that a new official does when he comes to Washington is to get himself an expert on petroleum. No office is complete without one."

At that time the "experts" were calling the Division to ask, "What is the difference between crude oil and fuel oil?" and "How does natural gasoline differ from service station gasoline?"

Those are actual questions that the Division staff answered in non-technical language.

It should be mentioned here that the Petroleum Administration for War* did a really fine war job and members of the oil industry served their country well both in Washington and in the field. The Division and the PAW enjoyed successful and close cooperation throughout the war.

Before and during the last war, when the Division was beset with extra projects to work out for different branches of the government, it had to have a separate appropriation from

*See "History of PAW," U. S. Government.

Congress for each new proposal. When asked for the survey on oil fields that could supply the aviation gasoline so greatly needed by the Allies, the Division had a great deal of the information at hand and produced this immediately. It waited four months for a $15,000 appropriation to complete the work. Even though projects grew tremendously in size and importance during the war, never did the appropriation for the Division come near the million-dollar mark nor did the technical personnel reach 150 individuals.

To paraphrase: "Never did so few do so much with so little."

That phrase will be appreciated when the war work of the Division is covered in more detail. Some of its findings are still restricted and, considering the world situation today, will remain so, but its vital part in war operations is evident in the results that can be revealed.

▸ **Serves public, too.** The Division acts for a third section of our nation —the public, or, to differentiate from the government and the industry, the individual consumers of petroleum products.

In a popularity contest for government agencies the Petroleum and Natural Gas Division would never be mentioned. Who ever told an asthma sufferer that the gas used to relieve his attack was developed by an obscure petroleum agency of the government? How would a consumer learn that the standardized analysis of petroleum products has helped to give him better products at less cost? Who could estimate the oil products available today because they were saved by pioneer conservation work of an agency in the Bureau of Mines?

The Division, like most research groups, is quiet about its work. Its accomplishments are known to parts of the government, a fairly large section of the oil and gas industry, and next to none of the general public.

One of the Division's projects of specific value to the public—all are designed for national benefit—is that devoted to maintaining quality in motor gasoline that is marketed. From 1920 to 1931 samples of gasoline were collected and analyzed toward this end. The starvation funds of the depression period forced discontinuation of gasoline surveys until 1935 when demand from automotive and petroleum industries caused the Coordinating Research Council to work out an agreement with the Bureau of Mines whereby oil companies supplied the results of their own surveys on competitive gasoline and the Division then tabulated these data and prepared a gasoline survey. As already mentioned the car owner owes much of his confidence in the gasoline he buys at any filling station in the country to the work of the Division.

▸ **On the other side.** The respect and admiration that the Division has won from the industry so overbalances any criticism that this may appear a one-sided account of the agency.*

In the scores of comments from

Aerial view of the Bureau of Mines Exell plant approaching from the South. Here the staff of able C. W. Seibel produces helium gas which once sold for a prohibitive $2500 a cu ft and is now obtainable for 1 ½ cents a cu ft. It is used in aviation, deep sea diving, anesthetics, asthma treatment, welding, leak detection, and other items that represent bonuses to the public from the long years of study devoted to helium by the Petroleum and Natural Gas Division. It is a product that industry could hardly afford to develop without commercial demand but the development has proved worthwhile.

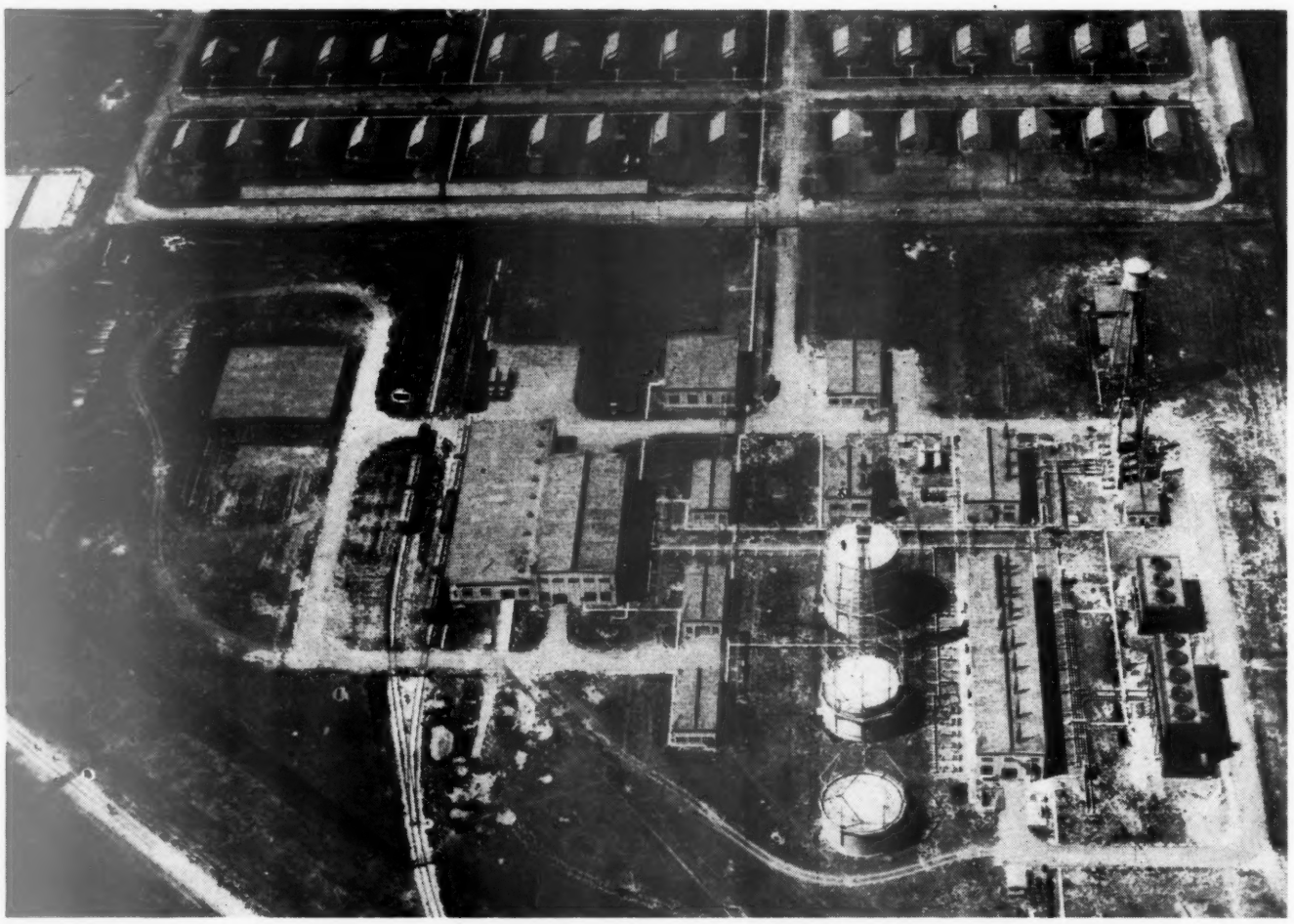
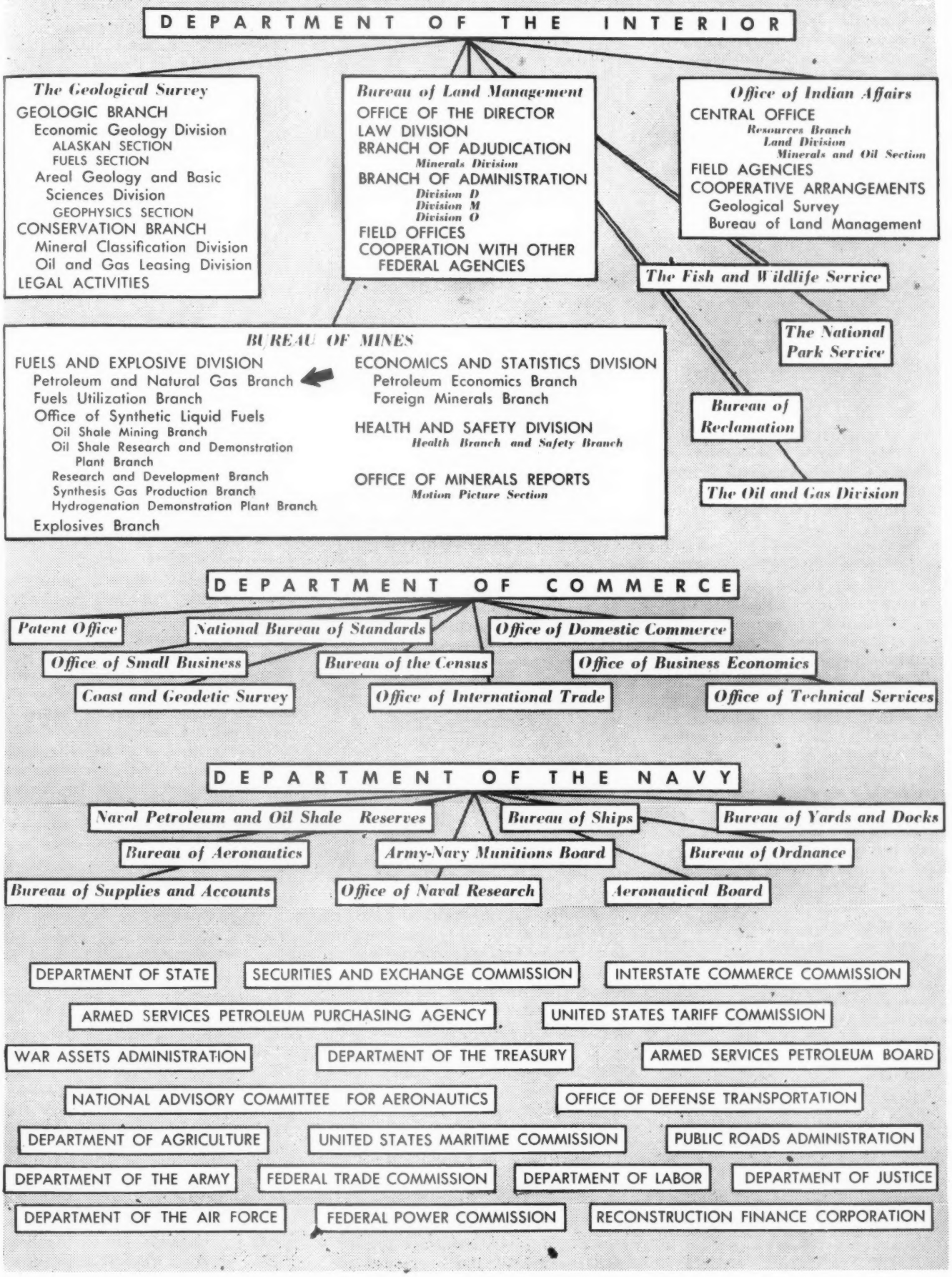


Fig. 1 Outline showing Federal agencies concerned with oil and gas activities.



Note: All designations here are those that went into effect January 1, 1948. Petroleum and Natural Gas Branch is called Division in the article.

large and small operators, however, only one person, who stated he did not speak for his company, said he had found no important use for the work of the Division, a condition which he ascribed to the inevitable handicaps of any federal bureau although he considered the staff "very capable men."

This points up the good judgment with which those who held the positions of director of the Bureau of Mines and chief of the Petroleum and Natural Gas Division have selected the personnel of the small group of scientists and engineers who make up the staff. One of the most repeated comments on the value of the Division has been the contribution it has made toward training young technicians who have later switched to industry and become key men in advancing efficient oil and gas operations.

But the Division would not be staffed by human beings and this would not be a democracy if there were no complaints. Some of them resolve into a matter of opinion and others can be corrected only if larger funds are available. There are few that are open to change under present conditions.

The most widespread criticism is the time lapse between the completion of a research project—or the accomplishment of part of the objective—and publication of the results so that industry can put the findings into practice without delay.

Part of this is the fault of the Division and part a lack of funds. The Division is a hound for accuracy and staff members are more likely to spend too much time to be sure they are right than to take a thousand to one chance their results are not exact.

There is argument here for both sides. One president of a large company referred to the publications of the Bureau as a "bible of the oil industry." This explains in some part the Division's zeal for accuracy and makes it difficult to blame a tendency to be overly meticulous.

In view of the amount of publishing that the Division does do and the work accomplished that should be reported more widely, the agency needs a department of publications to expedite the distribution of its findings. This would depend, of course, on appropriations.

Many in the industry do not realize that a great deal of the Division's material is placed for early release in the industry's publications, both in privately owned journals and in volumes put out by the large professional associations of the industry.

This is a point that should be met and solved in some manner to improve the relationship between the Division and the industry and to speed the use of technical improvements.

Though no one has made the suggestion, there should be greater distribution of bibliographies of the material the Division can supply individual operators. Too many do not know what information about their specific problems is available.

Despite its high record and its "bible of the industry" publications, there are still, in the flux of private industry of a democratic government, many operators who have no idea what the Petroleum and Natural Gas Division can provide in engineering data and information on research projects. Keeping the whole industry informed on what could be obtained would also require more funds but it would be well spent for the newcomers must also learn "this is why you should do that."

While some operators have praised the work of the Division on one project, others have insisted that the time would be better spent on another. In allocating its time and personnel and funds the Division has not always been right, certainly, but in going over its history, as we hope to do, we shall find that it didn't waste much time in dropping projects when they proved unprofitable. It has been off the beam completely on occasion but sometimes even these false starts have stimulated research in the industry that has proved valuable.

The industry doesn't know the mind-searchings that take place when the Division considers a new project. The staff must keep one eye on industry's research and the other rolls over survey results, equipment, funds, personnel, the government's needs, and the public's demands, before it launches a new project.

These criticisms of the Division's operation weigh lightly in comparison with its accomplishments. There are a few others and they come under matters of opinion and will be discussed at more length when present projects are taken up.

Praise has been generous and sincere. To quote a few top men in the oil industry:

"Its services have been vital to the progress of the oil industry and its continued activities are essential to the advancement of the technological processes so urgently needed in the exploitation of natural gas and crude oil reserves."

* * *

"The cooperative work (between the Division and the American Gas Association) has been helpful to the industry and the cooperation between industry and the Division has been very close."

* * *

"The Bureau's area of activity has been, and properly, not the duplication of work on the development of processes and production which the

***H. C. Fowler** first joined the Bureau of Mines at Bartlesville, Oklahoma, and is now supervising engineer of that station. He has been with the Bureau for a quarter of a century.*

Fowler began in 1923 and for the next four years was petroleum engineer assigned to safety work. In 1927 he became assistant chief of the Petroleum and Natural Gas Branch of the Bureau of Mines in Washington, D. C., and from 1928 to 1933 held the important post of acting chief engineer of that organization. In 1945 he returned to Bartlesville, Oklahoma, as supervising engineer, Petroleum Experiment Station, the position he now holds.

Two impressive works by Fowler, which supplied considerable background for this study, were historical accounts of the Bureau of Mines and the oil industry. One was written in 1933 and the other in 1941.

A native Californian, Fowler attended Stanford University, receiving an A.B. in Civil Engineering from that institution in 1915. He obtained valuable basic experience with the Associated Oil Company from 1916 to 1923 before working with the Bureau of Mines.

*I should like to point out that my prejudice, if that is the word, lies in the other direction. I have always found it difficult to believe that industry could not manage better by itself than with Federal aid if it would make the effort. In my study of the Division's work I began to see what the operator meant when he said he did not regard the agency as a government bureau.—E. A.

oil companies need to conduct for their own purposes, but rather basic work of general usefulness to the industry and also work on matters economically marginal at the time, or inherently non-economic but needed to supplement industry activities for the public good."

"The Division has made "worthwhile studies with regard to repressuring operations in the Middle District of Pennsylvania."

"The work of the Division in the realm of gas production has been of outstanding benefit to the gas industry and to the public it serves over a considerable period."

"Our definite overall opinion (is) that they are doing a constructive job of real benefit to the industry."

"We feel that the Bureau of Mines in this division has been invaluable not only to the public and the Government but to the oil industry as a whole."

"The value of the Bureau of Mines to the oil industry has been very great."

"The Bureau of Mines has made worthwhile contributions to the oil and gas producing branch of the industry in North Texas by assembling and correlating information that probably could not have been accomplished by individual persons or operators. This type of factual and impartial technical work should be continued as a valuable public service."

"Its engineering studies of fields and its publication of structure maps and other significant data have been of great help particularly to the smaller producers who do not have engineering staffs of their own."

"The Division has played a very important role in the progress of the industry and has greatly assisted it in attaining the present position of second to none . . . in the world."

"The value of the fundamental work carried out by the Division should not be minimized, for without it the entire load for such information would undoubtedly have to be carried by the industry under some cooperative basis. The alternative would be to have this load carried by individual companies, and considerable duplication would result."

"The Bureau was among the first to recognize the importance of solution gas and gas caps as sources of energy for the production of oil from a reservoir; as a result producing gas-oil ratios are kept at a minimum throughout the industry."

"Its greatest contribution was the men it trained and supplied the industry when petroleum engineering as now known was in the embryo stage."

"The safety work, with respect to protection of lives and property from fire, explosions, and toxic gases has been of inestimable value, and the work should definitely be continued."

"Throughout its range of scientific research and the practical application of its discoveries concerning the many problems faced by oil and gas business it has been most conscientious and cooperative . . . we cannot praise too highly the manner in which very important results have been obtained with very little publicity."

"Most recently the work of the Bureau on gas-condensate corrosion has been outstanding and a great contribution to a problem that has been of considerable concern. The recent Bureau publication on the pressure-volume-temperature relationship of natural gases containing nitrogen will fill a gap that has long been a handicap."

"The reports issued by the Division have earned respect and have contributed substantially to technological progress. Confidential data contributed by the industry have been handled with propriety. . . The Division is staffed and organized to conduct studies and investigations on a regional and nationwide scale that would be cumbersome for individual companies to match. In fact, by a consistent demonstration of integrity and ability, the Division has become a fine example of constructive cooperation between government and business, genuinely in the public interest."

"This station has always given us splendid cooperation and assistance.

The staff and the appropriations have always been small for the P&NG Division, one of the most beneficial agencies of the Federal Government.

TABLE 1. Bureau of Mines and Petroleum and Natural Gas Division appropriations and personnel, 1911-1948[1]

Fiscal year ending June 30	Direct appropriations		Number of fulltime employees paid from these appropriations	
	Bureau of Mines	Petroleum and Natural Gas Division	Bureau of Mines	Petroleum and Natural Gas Division
1911	$ 502,200	$ .....[2]	298	
1912	475,200	.....	304	
1913	583,100	.....	391	
1914	664,000	.....	426	
1915	730,500	25,000	418	
1916	757,300	35,000	430	
1917	981,060	70,000	550	
1918	1,467,070	100,000	648	
1919	3,245,285[3]	100,000	785	
1920	1,216,897	125,000	738	
1921	1,362,642	135,000	772	
1922	1,474,300	135,000	667	
1923	1,580,900	135,000	709	
1924	1,784,959	151,080	767	
1925	2,028,268	201,650	830	
1926	1,875,010	213,330	735	
1927	1,914,400	211,000	747	
1928	3,025,150	198,260	769	No
1929	2,725,118	208,480	881	record
1930	2,274,670	232,000	775	until
1931	2,745,060	234,040	805	1935
1932	2,278,765	232,860	763	
1933	1,860,325	183,200	739	
1934	1,574,300	150,000[4]	523	
1935	1,293,959	118,820	523	34
1936	1,970,311	237,866	664	62
1937	2,093,200	265,866	698	75
1938	2,272,720	253,000	685	75
1939	2,892,880	260,000	737	78
1940	2,980,499	260,000	799	76
1941	3,952,401	260,000	1209	81
1942	8,910,389	326,000	2104	84
1943	28,707,631	449,100	3851	112
1944	20,969,098	568,380	4300	144
1945	22,195,137	657,640	3974	147
1946	17,846,839	579,000	3375	143
1947	16,000,515	826,750	2862[5]	133[5]
1948	12,288,800	600,000		

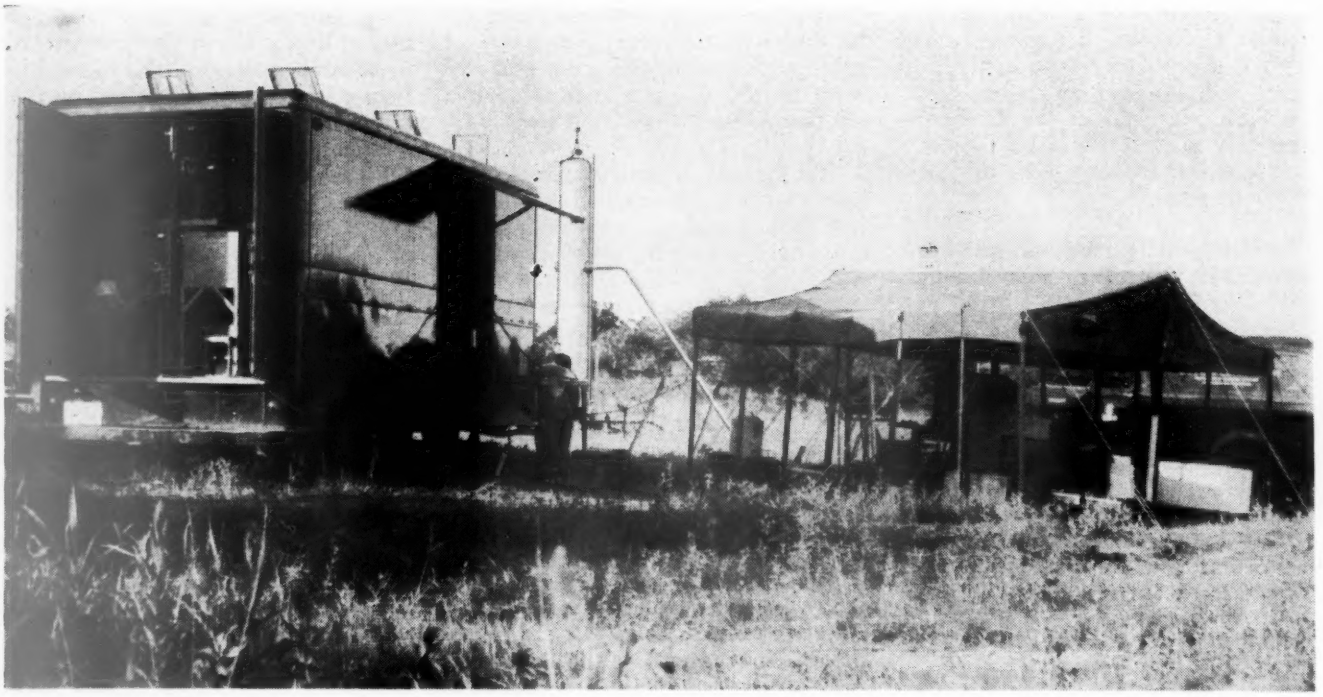
[1]Data taken from the budget and from the Annual Reports of the Director, Bureau of Mines, to the Secretary of the Interior (and to the Secretary of Commerce).

[2]Not separately allocated.

[3]This figure includes $1,586,388 for the establishment of the Government Fuel Yards, a non-recurring item entirely of a service nature. The net regular appropriation therefore was $1,658,899.

[4]Congress limited expenditures to a total of $111,683 in this year after the appropriations had been made.

[5]These figures reflect dismissals made at the end of fiscal year 1947 to bring employment in line with 1948 appropriations.



With this mobile testing laboratory the Petroleum and Natural Gas Division made rapid appraisals of gas-condensate fields for the nation's war effort, beginning in 1942. Need of a portable unit that could examine field conditions on the spot had long been realized but not until the war emergency were funds provided for the modern equipment needed. The big truck holds a separator for measuring liquid:gas ratios, a pump, a fractionating column, a steam boiler, and a gasoline-powered electric generator. The tent shelters unmounted apparatus and technicians at work.

...We have requested from them water analysis and suggested methods of treatment. They are engaged in making corrosion studies on our properties. They have made for us viscosity tests on crude oil, in fact we discussed with them many technical questions. ... Small operators do not have an engineer staff and their opportunity to secure advice from the Bureau of Mines can mean the difference between success or failure of the project."

"It is my personal opinion, as well as those of our organization who are familiar with the work of the Petroleum and Natural Gas Division, that the numerous services of the Division have been and continue to be of real value to the petroleum industry. From our long experience with the work of the Petroleum and Natural Gas Division in the many areas in which we operate, we believe the petroleum industry in general receives more for its tax dollar from the work of the Division than from most other governmental bureau subdivisions."

* * *

"The early study of well spacing... challenged the technologists of the oil industry toward aggressive thinking about reservoir fluid flow."

* * *

"The quality and value of current work of the Division, however, is excellent, and in our opinion there will always be research and experimental work that can best be carried on by the Division."

* * *

"Their research work on reservoir conditions and performance and in calculations of reserves and ultimate recoveries has been very helpful to all companies engaged in the production phase of the oil industry."

* * *

These are only a few of the comments of executives in the oil industry. It is a little hard to realize that the widespread approval encountered in our search for an estimate of the Division was bestowed upon a government agency by the highly individualistic oil industry.

Later we expect to present a brief outline of the history of the 34-year-old Petroleum and Natural Gas Division of the Bureau of Mines. Some may wonder why we select this group for presentation when there are so many federal agencies concerned with oil and gas. We count 73 units in Fig. 1 that have some interest in petroleum resources but will not contest any number close to that.

There are several reasons for limiting our discussion to the Division with mention of those organizations most closely associated with it.

In the first place the Division is the only federal agency designated by law to engage in research in oil and gas. Through the Bureau of Mines it has a mandate from Congress to carry out this program.

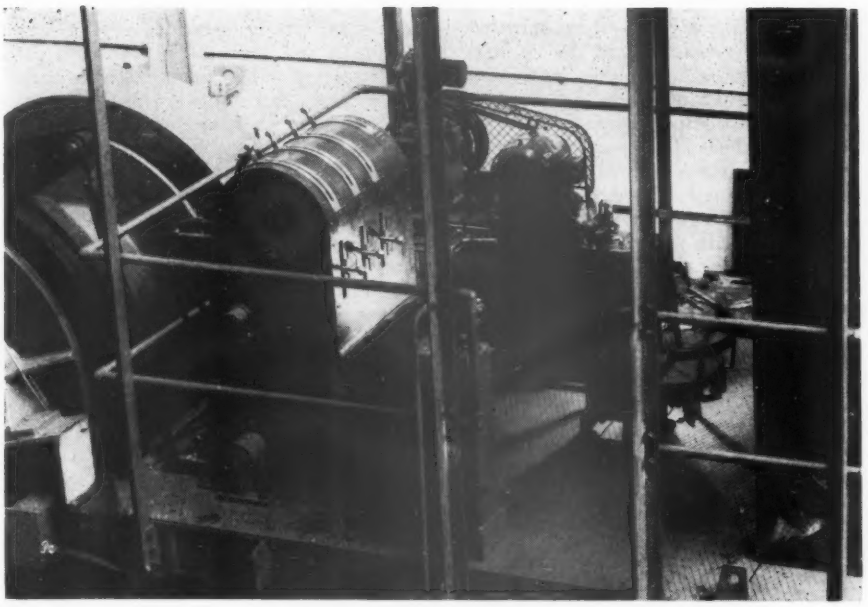
Also the Division has worked in closer cooperation with the industry over a longer period than any other government unit and many of their problems are shared. Of all the 73 units dealing with oil and gas in Fig. 1 oil men will agree the Petroleum and Natural Gas Division has been the most important in advancing efficient and economic operations. It is the keystone of the arch of conservation of our country's petroleum resources.

The Division was established in the early stumbling period when trial and error practices and lack of fundamental knowledge had the industry in a semi-lawless state. It stands at the head of the forces that spread order and conservation.

The Division is so thoroughly tied into the industry that a review of its past, an understanding of its present, and speculation on its future is an integral part of the history and plans of all petroleum operations in the United States. * * *

This is the first of a series of articles on the Petroleum and Natural Gas Division. The next one will appear in an early issue.

EXCLUSIVE



Operator's platform.

British Designed 150-hp 3-Drum Transportable Hoist

By F. G. BAILEY

An achievement in the engineering industry has recently made its appearance in England, the completion of a 150-hp three-drum transportable hoist designed for service at Abadan, Persia, the first of its kind to be constructed in England. So far, two of these hoists have been constructed, each being capable of exerting a line pull of 31,500 lb simultaneously on two drums at a speed of 60 fpm, or a pull of 20,000 lb on a single rope at a speed of 150 fpm. Each of the three drums takes about 2500 ft of rope, and has a rope speed of 60 fpm when running in low gear and 150 fpm in high gear.

The hoists will be used in conjunction with derricks and other types of lifting gear for the erection of refinery equipment, such as fractionating columns and towers of various types, ranging up to a height of 150 ft and a weight of 225 tons. In cases where this height is exceeded, it is proposed to raise the derricks to the main structure, the hoists remaining at ground level. Each hoist will work with a single boom derrick or a pair of masts, using a wire rope of 7/8 in. or 1 in. diam. In the cases of heavier loads two masts will be used with two sets of sheave blocks, each having 22 parts.

Although these hoists weigh approximately 40 tons each, the nature of the work involved makes it imperative for them to be transportable, and this has been achieved without dismantling. They can be moved from site to site in accordance with the erection program. To carry this out successfully, these hoists will not be set on prepared foundations in service but placed on ground level and anchored at the rear by the use of dead men. These will consist of pipes 12 in. in diam placed horizontally about 5 ft below surface level. A further restricting factor in design was that the machines had to be kept within the loading gauge of the refinery railway system, so they could be moved easily in rail trucks from one location to another. As an alternative method of transportation, low-loading tractors will be used.

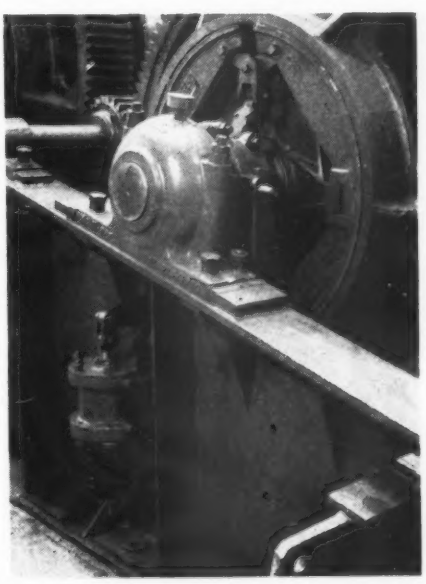
Extreme care and attention was found necessary in the design and construction of these hoists, especially in view of the fact that they will never be laid upon prepared foundations in service, as the main frames have to remain rigid and in true alignment when the equipment is placed on uneven ground. For convenience in handling and to reduce weight or size when it is necessary to remove a hoist, the main frame has been constructed in two sections. The front carries the three main drums and the slewing gear together with their gearing, clutches, brakes, pawls, and the motor for the slewing gear. The rear section comprises the operator's platform, in which is situated the control station, the air compressor for operating the main clutches, the controllers for housing and slewing motions, and the contactor cubicle for the main 150 hp slip-ring motor. The main motor, gearbox and "thrustor" brake and the resistance boxes for the two motors are housed underneath the platform.

The framework of the hoist is constructed of all-welded steel, and is well braced by heavy cross-members, which form a rigid bedplate to hold securely the drums and their driving gear. For the purpose of insuring true alignment when assembling on the site, the two sections of the main frame are accurately machined and they are placed in position by means of pins before being securely fastened together by the necessary bolts. For purpose of a regular inspection of the electrical and mechanical equipment, a series of removable light panels are fitted in the sideplates of the frames. The continuous nature of these side plates and panels form an outer dustshield for the chain-drive gear and bearings, which are situated beneath the drums and control platform.

The chain and gearbox are totally enclosed and an oil and dustproof casing covers the transmission gears. The front portion of the machine weighs approximately 28 tons, and to assist its movement by cranes, lifting beams can be inserted through three-square section cross members of tubular design set at fixed intervals across the frame.

The 150 hp 980 rpm main motor is adjustably mounted on girders of heavy steel, which form the base of the structure holding the elevated control plat-

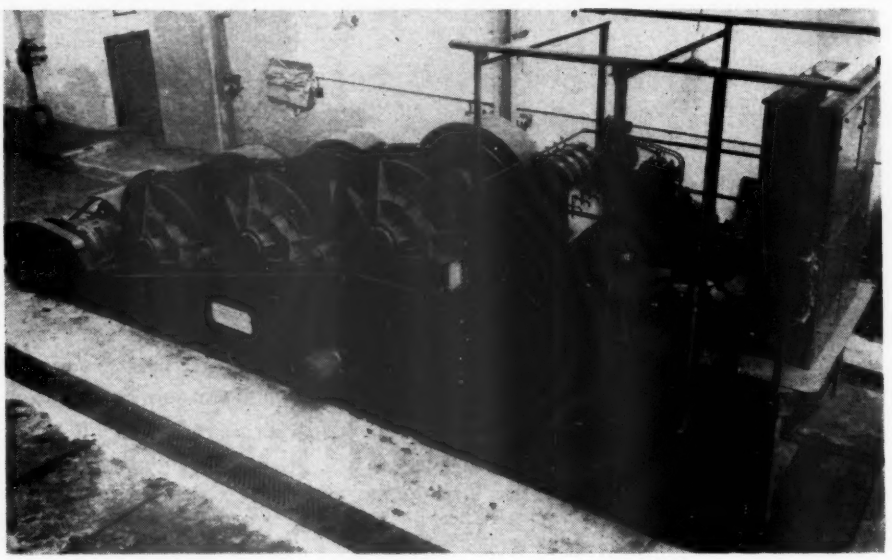
Hoisting drum clutch.



form. This main motor drives the hoisting drums through a chain belt and a two-speed gearbox, as illustrated, which incorporates a claw clutch for deciding high or low hoisting speeds. Power is then transmitted from the gearbox to the spur wheel of the first hoisting drum through an idler gear. A large sized brake drum is fitted on the main driven shaft of the gearbox, and this brake operated by a 250 hp "thrustor," has sufficient power to stop and hold the hoisting drums under load. The brake drum in question works in conjunction with the control gear on the main motor, and is therefore independent of the braking system fitted to each drum. The first drum spur wheel drives the wheels of the succeeding drums through intermediate idler pinions. The whole of the gear shafts and pinions are mounted on roller bearings.

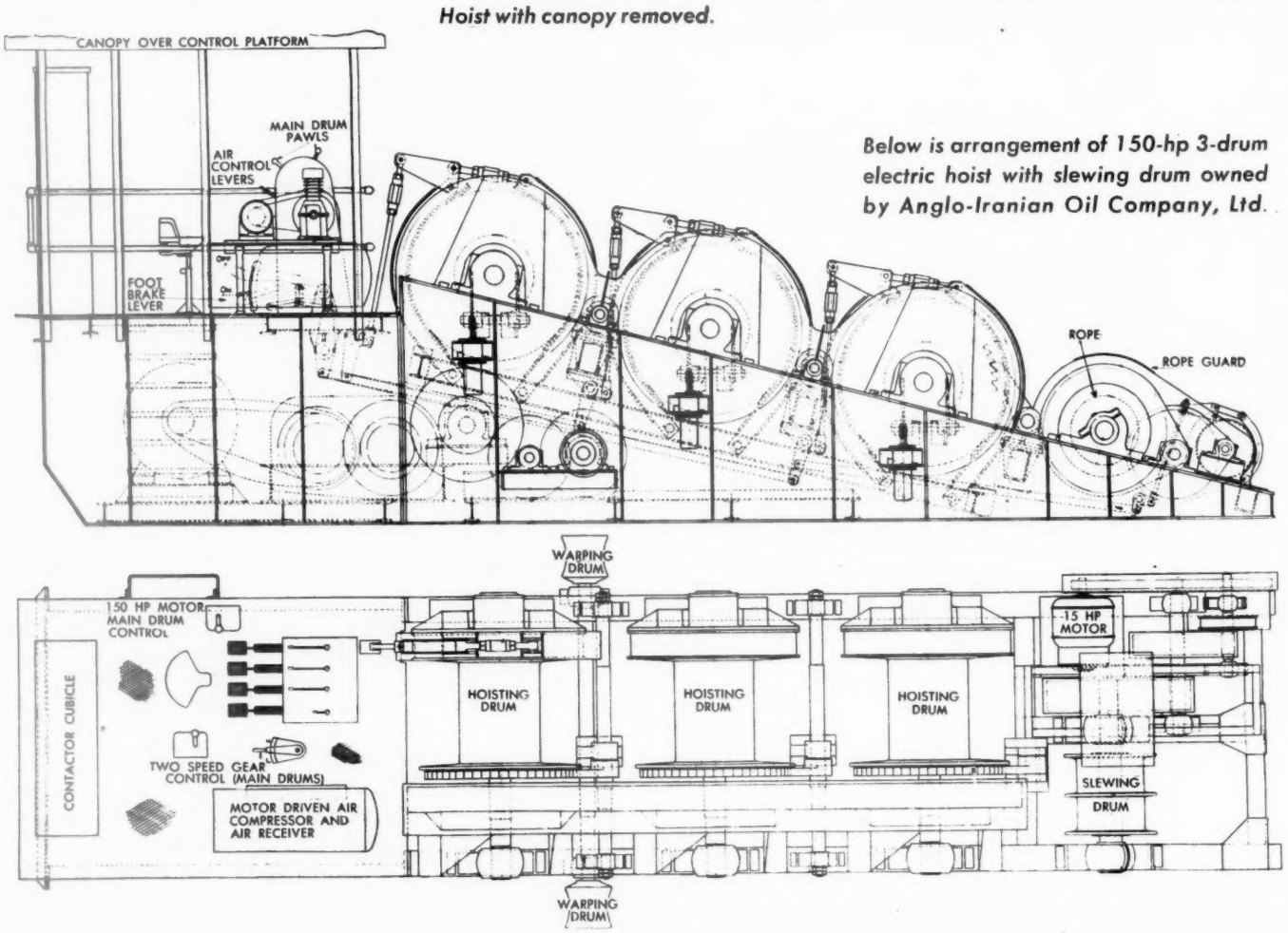
The mechanism of the hoisting drums, each of which is identical in design, is illustrated. The drums are not fixed to the drumshafts, but are freely mounted on roller bearings on the shafts and driven through epicyclic gearing. Power is transmitted from the spur wheel to the drumshaft through the double toggle friction clutch of the manufacturers' own design. This clutch is most effective in operation and, when fully engaged, combines a smooth pick-up of drive with a rigid locking action. It is operated by a single-acting compressed air cylinder, the piston being spring-loaded to disengage and withdraw the clutch when the air pressure is released. When air is admitted into the cylinder an upward movement of the piston rod actuates a crank arm, forcing a sliding sleeve on the mainshaft inward toward the super wheel. Two toggles are coupled to this sleeve, each of which reacts on a further pair of toggle levers and forces outward two heavy friction shoes into contact with a large friction drum on the side of the spur wheel. The bodies of the friction shoes are slideably connected by a pair of heavy keys to a cast-steel driver secured on the main drumshaft. The length of the inner pair of toggles is quickly and easily adjusted by a screw and a locking nut to set the friction shoe working clearance and take up any wear in service.

On the opposite end of the mainshaft, the driver is transmitted to the hoisting drum through a pair of planet wheels fixed between a pinion cut in the shaft and an internal gear ring fixed to the inner circumference of the drum flange. These wheels, as shown on the drawing,



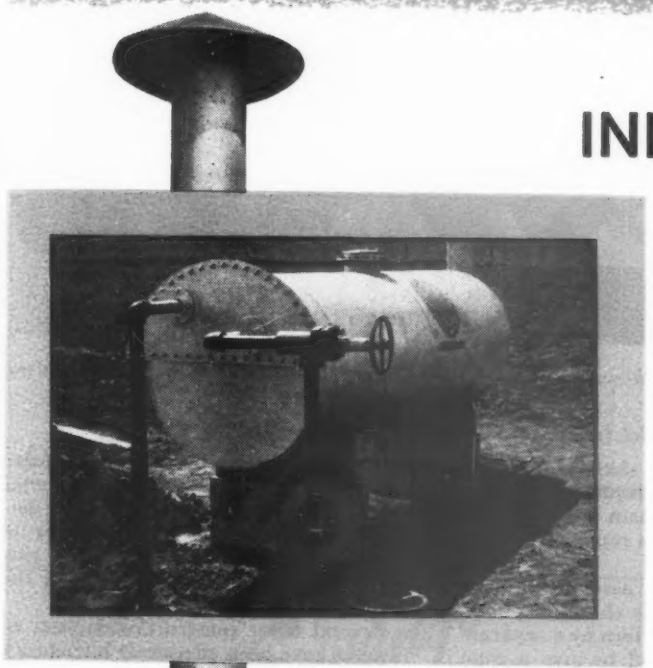
Hoist with canopy removed.

Below is arrangement of 150-hp 3-drum electric hoist with slewing drum owned by Anglo-Iranian Oil Company, Ltd.



NO FURNACE FAILURES

WITH THIS *NEW* INDIRECT GAS HEATER



Maloney-Crawford's new indirect gas heater provides more furnace area, resulting in lower heat transfer per square foot—thus eliminating the possibility of furnace failure. Maloney-Crawford gas heaters have many outstanding features including:

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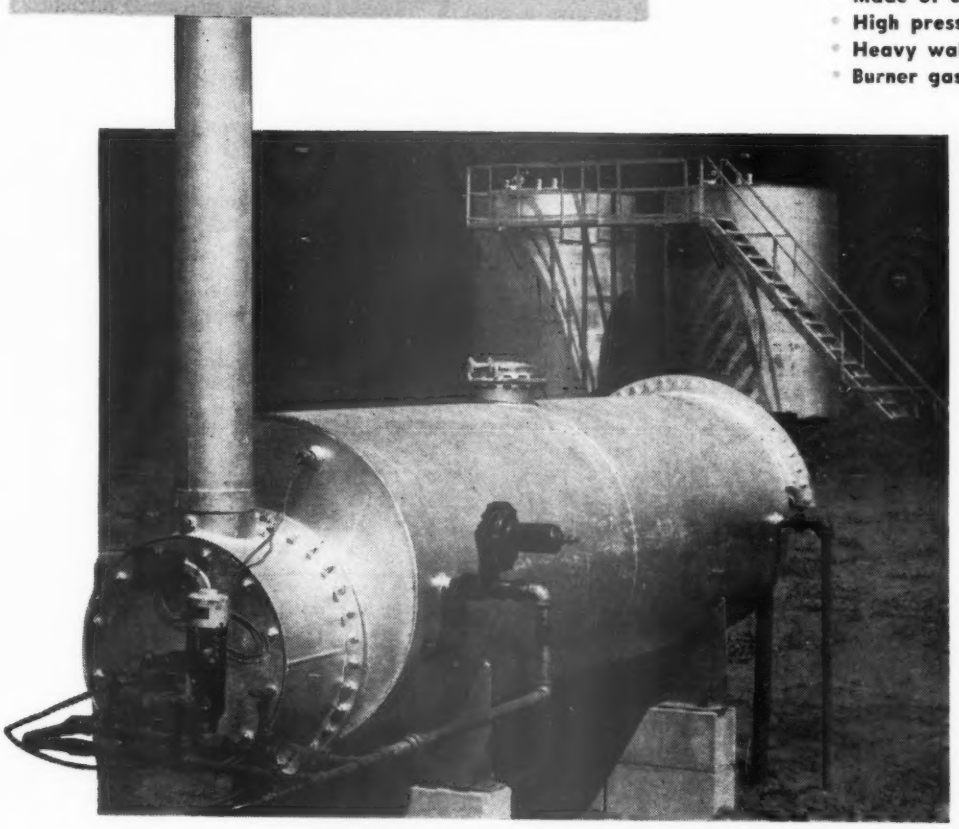
- Low water loss.
- Thermostat control.
- Made of corrosion resistant materials.
- High pressure heating coil outlet.
- Heavy wall burner tube assembly.
- Burner gas piping manifold.



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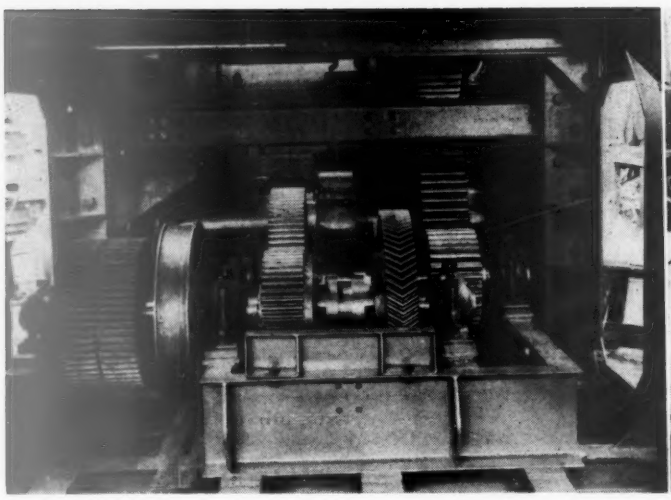
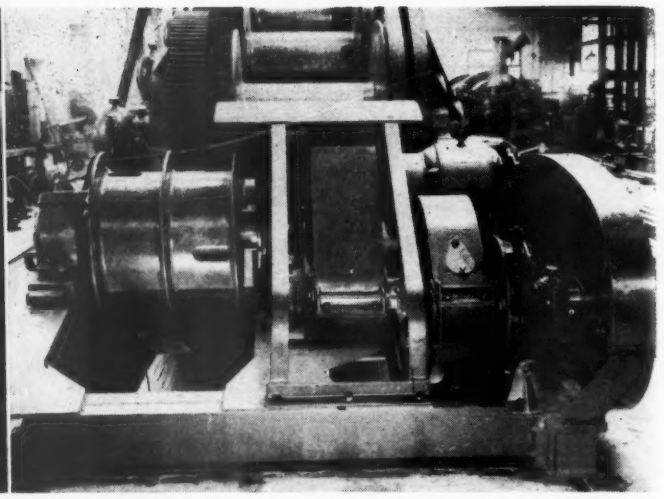


Main drive gear box.



Slewing drum mechanism.

are mounted on the end member of the drum, which as well forms the main side bracket and pedestal for the drumshaft.

The drums are designed to carry up to 2800 ft of rope of 1 in. diam up to ten layers. A large cast-steel ratchet wheel is bolted to each flange of the drum adjoining the clutch. Working in conjunction with the ratchet is a heavy steel pawl, operated from the platform of control by hand lever through what is known as Hans Renolf "push-pull," remote control chain operating gear.

Fitted to each drum are powerful brakes of the caliper type, operated through a series of levers, the first being a toggle lever fixed at the brake post. Means of rapid brake adjustment are provided and the lining of the brake is bolted in renewable sections to the shoes.

The two warping drums, shown on either side of the hoist, are keyed to the ends of a common driving shaft fixed in ball bearing pedestals within the main frame. The shaft is driven through a dog clutch and a double set of spur gears from the idler wheel shaft of the main drive. When driven through the high speed side of the main gearbox, the warping drums have a rope speed of 90 fpm.

The slewing drum assembly at the front of the machine is shown in photograph. This drum is driven by a separate 15 hp motor, designed to give a rope speed of 30 fpm with motor control creeping speed. As each end of the rope has its own section of drum, it is capable of coiling in a satisfactory manner. The drumshaft is driven by the motor through a chain belt and double reduction gears, totally enclosed.

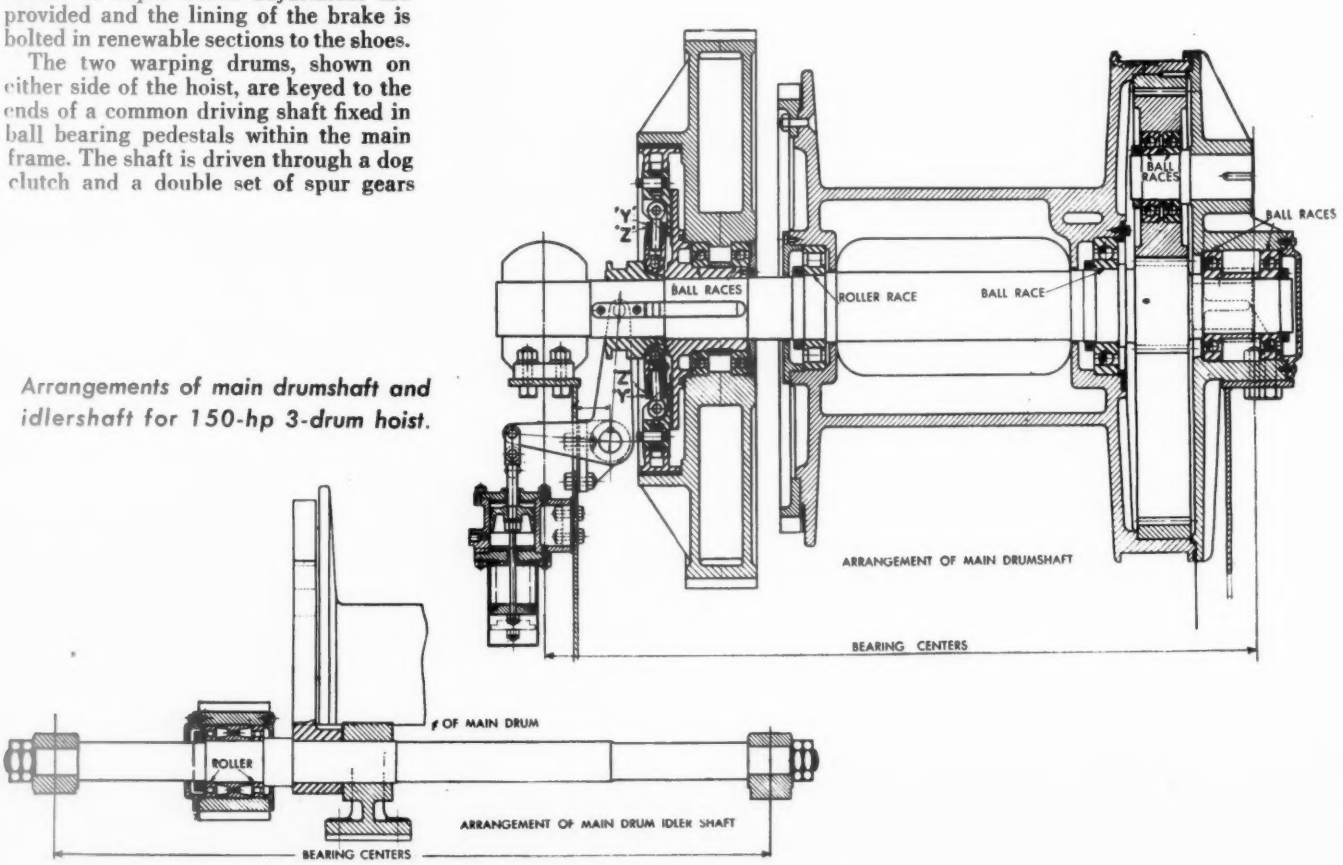
The drumshaft is mounted on angular pedestals on plain renewable gunmetal bearings. A brake drum on the first motion shaft of the transmission gear is fitted with a brake of a band-type pattern, operating through links from the main control platform.

Several other constructional items of interest have been effectively introduced in the manufacture of these hoists, such as the design of the control gear, dust sealing arrangements, etc.

The writer is indebted to the Sheepbridge Coal and Iron Company, Ltd., for information and illustrations contained in this article.

★★★

Arrangements of main drumshaft and idlershaft for 150-hp 3-drum hoist.



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Annual Savings: $2626.50

Yearly fuel costs for a Cummins-powered tractor used on a 750-mile round trip highway haul are $2626.50 less than the fuel costs for a gasoline-powered unit on the same run. That's because the Cummins-powered rig, while hauling 7000 pounds more each trip, operates at a ton-mile cost of 1.84 mills against 3.45 mills for the gas job.

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Yearly fuel costs for a Cummins Diesel on an off-highway hauling job are $1138.80 less than the fuel costs for a unit powered by another make of diesel doing similar work. That's because the Cummins-powered unit, while making more trips and carrying heavier loads, uses 25.7 gallons of fuel per shift against 33.5 gallons per shift for the other diesel.

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LAUGH WTIH BARNEY

The farmer's daughter and another farmer's son were walking along a road together.

The lad was carrying a large pail on his back, holding a chicken in one hand and a cane in the other and leading a goat. They came to a dark lane.

Said the girl: "I'm afraid to walk here with you. You might try to do something that's not very nice."

"How could I, with all these things I'm carrying?"

"Well, you might stick the cane in the ground, tie the goat to it and put the chicken under the pail."

* * *

Sign on a Scottish golf course: "Members will kindly refrain from picking up lost golf balls until they have stopped rolling."

* * *

"Gracie, I think your husband dresses nattily."

"Why the rat! Who's Natalie?"

* * *

A man pinned underneath his car after an accident was being questioned by a policeman.

"Married?"

"No. This is the worst fix I was ever in."

* * *

Sweet young thing: I like men with blue eyes and green backs.

After spending two days and nights in a hotel bedroom, waiting for clear weather in order to continue ferrying an airplane to Birmingham, Alabama, I was quite bored.

To relieve the tedium I opened the Gideon Bible that had been placed in my room. Pasted on the inside cover was a sheet which said, "If you are lonely and discouraged, read Psalms 23 and 27.

I turned to the 23rd Psalm and read it through. Turning the page to read the 27th Psalm, I noticed a pencilled note in the margin, written in a scrawled feminine hand. "If you are still lonely," it said, "phone 1864."

* * *

Huge truck with two signs on the rear tells motorists: "Left, passing side—Right, suicide."

* * *

Patient: I suppose the operation will be dangerous, doctor?

Doctor: Nonsense! You couldn't buy a dangerous operation for forty dollars.

* * *

We know a little girl who is wanted by the police—and the firemen and the sailors, too!

* * *

A small boy once defined a lie as "an abomination unto the Lord and a very present help in time of trouble."

HE HASN'T BUDGED SINCE HE CRAWLED IN 3 WEEKS AGO··· —SAYS HE'S A LANE-WELLS BRIDGING PLUG!!
Dr. Otto B. Lockedup
PHSYCHIATRIC CONSULTATION
HUBENTHAL

There was a drunk who was a habitual slot machine gambler. One day he staggered into the Automat and walked up to the sandwich section, deposited two nickels and a ham sandwich came out. Presently, after depositing twenty nickels, he had ten sandwiches. The manager walked over to him and said, "Pardon me, sir, but why don't you stop—haven't you got enough?" Whereupon the drunk exclaimed, "What! Quit now when I am on a winning streak?"

* * *

A Quaker heard a strange noise in his house at night. He found a burglar busily at work. The burglar departed hastily when the Quaker walked in with his gun and said, "Friend, I would do thee no harm for the world and all that is in it, but thou standest where I am about to shoot."

* * *

And then there was the cat who ate some cheese and breathed down the rat hole with baited breath.

* * *

A mother took her young son to the store to buy a sweater. The only style in stock was the V-neck sweater. As each sweater was shown to the boy he shook his head and said, "No, I don't want that kind."

Finally, the mother in desperation, asked the boy why he didn't want a V-neck sweater.

His reply was quick and to the point: "My teacher wears that kind and every time she bends over you can see her lungs."

He went home without a sweater.

* * *

A young man about town, approaching a cigar counter behind which stood a cute young thing, said: "Do you keep stationery?"

Said the cute young thing: "Yes, up to a certain point; then I just go all to pieces!"

* * *

Married women drive slower than married men—because women will do anything to stay under thirty.

* * *

A woman wears a sweater to accentuate the positive and a girdle to eliminate the negative.

* * *

A sailing vessel is called "she" because she makes her best showing in the wind.

* * *

Stern Father (sarcastically): Say, young man, it's past midnight. Do you think you can stay with my daughter all night?

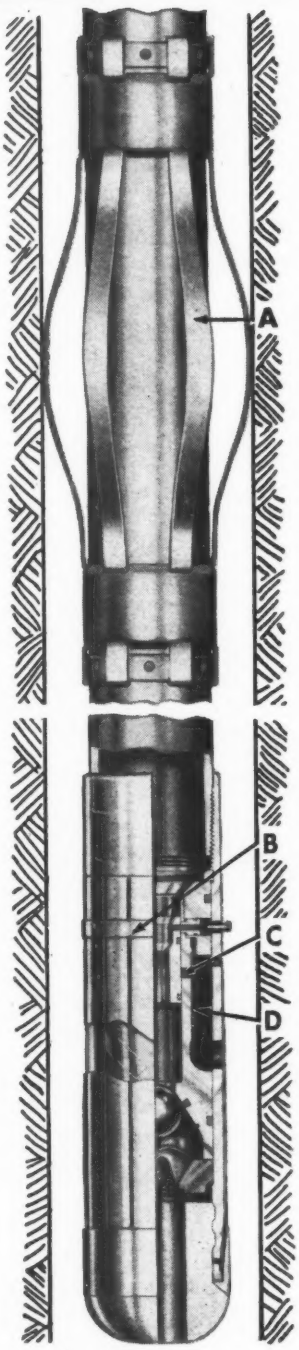
"Gosh! I reckon so, sir, if you insist. But I'll have to telephone Mother first."

WITH A

BAKER *Triplex* CEMENTING SHOE...

You secure a good "first-time" cement job while protecting permeable low-pressure zones below the shoe from contamination.

Here's how it is done . . .



A Baker Casing Centralizers (Product No. 910) are installed on, and above, the shoe joint to center the casing and provide a uniform annulus to receive the cement slurry.

B A hold-down strap (secured by shear screws) retains the Baker Metal Petal Basket close against the shoe or collar while running-in the casing and conditioning the hole.

C Cementing ports are covered by the Tripping Valve until cementing is commenced.

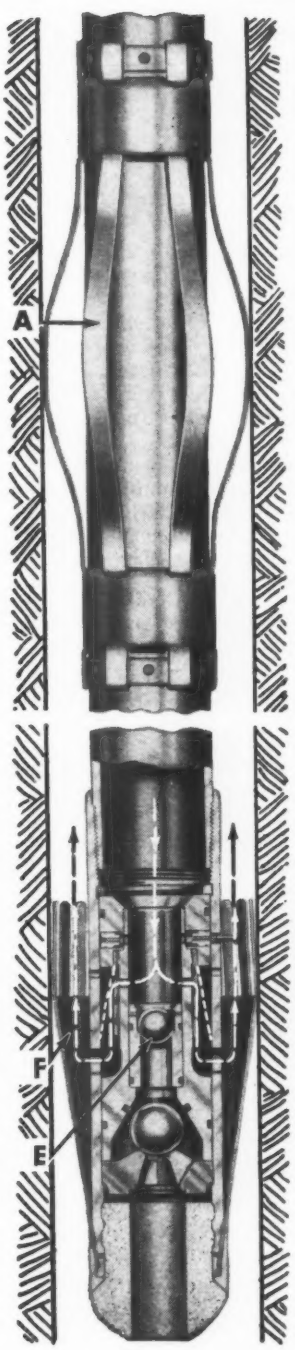
D A fabric-reinforced, resilient rubber, sleeve-type, back-pressure valve opens readily (see dotted white line) to permit passage of the cement slurry into the annulus above, but closes instantly to prevent any return flow of the slurry.

E After reaching the desired point in the hole, circulation is established through the ample central passageway. A Tripping Ball now is pumped (or allowed to gravitate) down the hole to seat upon the Tripping Valve. Pressure of 400 to 500 psi is applied to the casing, which shears the Tripping Valve shear screws and forces the Tripping Valve downward to expose the cementing ports.

F Shearing the screws also releases the Basket hold-down strap and allows the Metal Petal Basket to expand outwardly against the wall of the hole. The Basket with which each Triplex Shoe is equipped has a wide range of expansion and forms a bridge in large-diameter, or irregular-shaped holes far beyond the range of a rubber packing element.

The cementing operation now is carried out in the conventional manner with the cement slurry directed upward with the exclusive Baker "Whirler" action. This "Whirler" principle has proved to be far superior to an undirected jetting action which does not minimize the hazard of channeling, and may wash out cavities and cause cement contamination.

Only readily drillable materials are used for all internal parts; and two one-half inch set screws hold the inner assembly stationary to facilitate drilling out.



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BAKER *Triplex* CEMENTING SHOE

Capital Formation in the Petroleum Industry*

By JOSEPH E. POGUE, Vice President, and FREDERICK G. COQUERON, Staff Associate,

The Chase National Bank

● **Introduction.** Capital may be defined as "wealth employed in or available for production." All production requires capital. Expanding industries require more capital than static ones, and technological industries employ more capital than those in which little equipment is needed. The petroleum industry is both rapidly growing and highly technological, and, being a large industry, its capital requirements are prodigious, amounting to about one-seventh of the total of all American business, excluding agriculture.[1]

Capital formation may be defined as the method by which the wealth or capital needed in the productive processes is created. There are various ways in which capital funds may be obtained but there is only one way in which capital can be created—out of production in excess of consumption, that is, savings. The physical realities are simple, but the monetary concepts are complicated because the mechanism of credit can draw upon future savings.

● **Source of capital funds.** An industry, such as the petroleum industry, can obtain its capital funds from several sources: (1) internal, from its retained cash earnings, and (2) external, from borrowings and from the sale of securities to the public. The internal source makes use of the industry's own savings. The external source draws upon the savings of others, which may be past, present, or future (i.e. enforced) savings. Obviously, the internal source should be predominant, for if no industry generated its own capital, there could be little capital formation. It follows, then, that the higher the degree of internal generation of capital, the sounder the industry financially and the greater its stabilizing influence upon the entire economy.

● **Internal capital formation.** By means of a study of the combined operating and financial results of a group of 30 representative oil companies, as conducted by the Petroleum Department of the Chase National Bank[2] for the years 1934 to the present, it is possible to trace the processes of capital formation in a large segment of the petroleum industry and to portray its relationship to prices, costs, and rates of expansion.

For the last 14 years, 1934-1947, the group of 30 oil companies has struck a balance between the amount of capital expenditures and the amount of cash generated internally from net income retained after dividends and from non-cash charges for depreciation, depletion, and the like. The record is shown in Table 1. It may be observed that in only three years of this period—1937, 1946, and 1947—did capital expenditures run materially ahead of the internal cash generated and available for such purposes. These figures do not mean that the group had recourse to the capital markets in only the three years mentioned, for the expansion of the companies required increasing amounts of working capital. The average growth in this item from 1939 to 1946, inclusive, has been 90 million dollars per year. In addition, the 30 oil companies have made fixed capital investments in non-consolidated and associated companies during this period. In general, however, the petroleum industry has been able to generate most of its capital needs, with the favorable result that its borrowed capital is about one-eighth of the total capital employed.

In this process of capital formation, the 30 oil companies have been retaining a growing percentage of their net income for reinvestment. For example, in the five years, 1934-1938, the proportion of retention was 42.9 per cent; in the five years, 1939-1943, the part ploughed back was 48.2 per cent; in the three years, 1944-1946, the percentage had risen to 54.6; and in 1947, approximately two-thirds, or 65.1 per cent, is the estimated proportion of net income retained for reinvestment. The stockholder, therefore, has been making a growing contribution to the process.

● **External funds.** The funds raised by the 30 oil companies in the capital markets are analyzed in Table 2 for the last three years, 1945-1947. A steady, though not marked, increase in the total raised is revealed, but since part of the new capital is employed to retire old capital, the net additions are limited though revealing a rise to 508 million dollars in 1947. It will be observed that in 1947 the gross borrowings declined from 1946, but there was a substantial recourse to equity financing in the amount of 204 million dollars, of which 175 million dollars was in the form of common stock and 29 million dollars, preferred stock. The borrowings of 472 million dollars were divided as follows: From banks, 64.4 per cent; from insurance compa-

TABLE 1. Trend of capital formation of 30 oil companies. Years 1934-1947.

Year	Cash income from earnings*	Preferred and common dividends paid in cash†	Balance available for capital expenditures	Capital expenditures‡	Cash income from earnings in excess of capital expenditures
	Million dollars				
1934	616	128	488	461	27
1935	740	120	620	517	103
1936	922	234	688	634	54
1937	1139	289	850	929	—79
1938	859	200	659	669	—10
1939	885	189	696	665	31
1940	957	209	748	657	91
1941	1178	269	909	810	99
1942	1017	238	779	786	— 7
1943	1210	260	950	931	19
1944	1513	308	1205	1096	109
1945	1647	311	1336	1116	220
1946	1552	351	1201	1379	—178
1947Ⓔ	2096	446	1650	1950	—300

ⒺEstimated.

*Net income plus non-cash charges (capital extinguishments, income applicable to minority interests, provision for contingencies, etc.).

†Includes dividends paid to minority interest stockholders.

‡Represents investments in domestic and foreign facilities, including cost of dry holes. Excludes expenditures of a fixed capital nature represented by security investments in and advances to non-consolidated subsidiaries and associated companies.

*Presented before the American Institute of Mining and Metallurgical Engineers, New York, N. Y., February 17, 1948.

1. The economic report of the President, Washington, January, 1948, Table 19, estimates the 1947 expenditures of all American business (excluding agriculture) for new plant and equipment at 15.68 billion dollars. We estimate that the 1947 capital expenditures for domestic facilities by the group of 30 oil companies amounted to 1.65 billion dollars. This figure, after excluding outlay for dry holes, indicates expenditures of 2.10 billion dollars for the entire American petroleum industry in the United States. The oil expenditures represent 13.4 per cent of "all business."

2. See "Financial Analysis of Thirty Oil Companies for 1946," The Chase National Bank, pamphlet, August, 1947, for data covering the years 1934-1946 and for names of the companies composing the group.

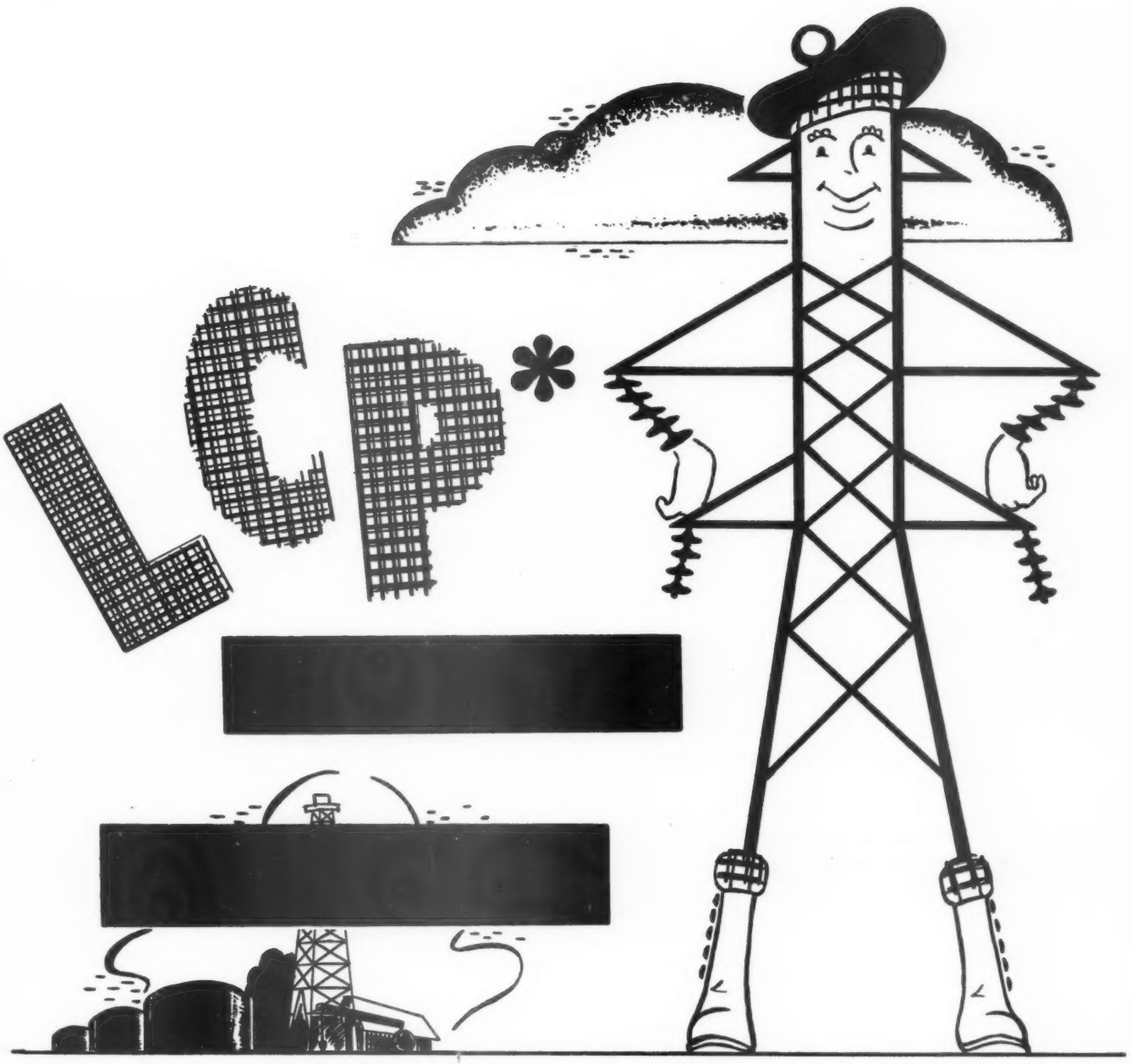

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TABLE 2. Analysis of capital raised from external sources by 30 oil companies. Years 1945-1947.

Year	Borrowings	Preferred and common stock issued	Sale of fixed assets and other transactions	Total new capital	Long-term debt retired	Preferred stock redeemed	Net new capital acquired
	Million dollars						
1945	411	77	29	517	380	94	43
1946	586	21	11	618	454	11	153
1947(E)	472*	204†	15	691	180	3	508

(E)Partly estimated.

*Analysis of borrowings from:

	Million dollars	Per cent of total
Banks	304	64.4
Insurance companies	165	35.0
Public investors	0	0.0
Others	3	0.6
Total	472	100.0

†Preferred stock, 29 million dollars; and common stock, 175 million dollars.

TABLE 3. Capital investments of 30 oil companies segregated into expenditures on basis of 1939 costs and expenditures caused by rise in construction costs. Years 1939-1947.

Year	1. Capital expenditures of 30 oil companies	2. Index of construction costs in 30 cities*	3. Capital expenditures expressed in 1939 costs	4. Indicated expenditures absorbed by rise in construction costs	5. Per cent of expenditures represented by rise in construction costs
	Million dollars	1939=100	Million dollars 1+2	Million dollars 1—3	Per cent
1939	665	100	665	0	0.0
1940	657	112	587	70	10.7
1941	810	119	681	129	15.9
1942	786	132	595	191	24.3
1943	931	138	675	256	27.5
1944	1096	143	766	330	30.1
1945	1116	148	754	362	32.4
1946	1379	176	784	595	43.1
1947(E)	1950	234	833	1117	57.3

*Source: American Appraisal Company. (E)Partly estimated.

TABLE 4. Capital expenditures of 30 oil companies, actual and deflated cost expressed in dollars per barrel of crude processed. Years 1939-1947.

Year	Capital expenditures		Crude run to stills	Capital expenditures		
	Actual	In 1939 costs		Actual	In 1939 costs	Difference due to rising costs
	Million dollars		Million bbl	Dollars per bbl		
1939	665	665	1141	0.58	0.58	0.00
1940	657	587	1166	0.56	0.50	0.06
1941	810	681	1283	0.63	0.53	0.10
1942	786	595	1170	0.67	0.51	0.16
1943	931	675	1316	0.71	0.51	0.20
1944	1096	766	1526	0.72	0.50	0.22
1945	1116	754	1562	0.71	0.48	0.23
1946	1379	784	1621	0.85	0.48	0.37
1947(E)	1950	833	1750	1.11	0.48	0.63

(E)Partly estimated.

nies, 35.0 per cent; and from other sources, 0.6 per cent. The projected relationships of internal capital formation and capital expenditures suggest that the 30 oil companies in 1948 may not increase their demands upon the capital markets, but rather will probably supply a greater part of their needs from internal sources than in 1947.

● **Factor of rising costs.** The upward trend in the capital expenditures of the 30 oil companies is caused in the main by the influence of two powerful factors: (1) the physical growth in the demand for oil, and (2) the rising cost of drilling wells and constructing refineries, pipe lines, and other facilities. It would be of interest to segregate these two components. This separation may be approximately accomplished by deflating the actual expenditures so that they are shown in terms of 1939 costs and then subtracting the adjusted series from the actual figures to yield a set of figures representing the expenditures made on account of higher costs. The data and computations are shown in Table 3.

Observing the data for 1947, by way of example, it will be noted that the total capital expenditures of 1950 million dollars are broken down into two parts—833 million dollars representing expenditures expressed in 1939 costs, and 1117 million dollars representing expenditures incurred because of the rise in costs from the 1939 level. It thus appears that for each dollar expended in 1947 for facilities, 57.3 cents went to cover *increased costs.* Accordingly the 30 oil companies spent a base amount of 833 million dollars and an extra amount of 1117 million dollars to cover the rise in costs.

We thus see how rising costs affect prices, for obviously this additional sum had to come mainly from the cash earnings of the industry, which called for higher oil prices. This expenditure on account of higher costs represents 63 cents per bbl of crude oil processed in 1947 by the group. In the same year, the average price of 36-gravity crude oil averaged 52 cents higher than in 1946.

It is difficult to find a satisfactory cost index with which to deflate capital expenditures to a basis of 1939 costs. None exists in the petroleum industry itself, and the industry's rise in costs is complicated by the presence of technological factors such as deeper drilling, more complicated refinery equipment, and the like. The American Appraisal Company publishes an index of construction costs in 30 American cities, which has been selected as reasonably satisfactory (see Table 3). At first glance it might appear that this index shows a greater rise than is reasonable for oil, but a careful comparison with specific cost changes in oil facilities suggests that this index when applied to oil industry expenditures does not overstate the cost factor. Moreover the Petroleum Department's index of per-well drilling costs indicates for the years covered a greater rise than the American Appraisal Company's index.[3] Therefore, the index used in our computation probably throws back into the base figures part of the higher costs resulting from technological changes. (See table at bottom of page.)

● **Relation to expansion.** Considering next the deflated capital expenditures of the 30 oil companies, which reflect mainly the element of physical growth, this series is compared in Table 4 with the crude oil processed. It may be observed that the deflated expenditures have not expanded as rapidly as the volume handled. Expressed in terms of dollars per barrel of crude-run-to-stills, the figures show that the deflated expenditures per barrel have followed a downward drift from 58 cents per bbl in 1939 to 48 cents per bbl in each of the three years, 1945-1947, while the expenditures on account of higher costs show a marked rise in 1946 and 1947, amounting to 63 cents per bbl in the lat-

s	1939	1940	1941	1942	1943	1944	1945	1946
American Appraisal Company Index of construction costs	100	112	119	132	138	143	148	176
Petroleum Department Index of drilling costs per well	100	107	101	116	143	159	215	217

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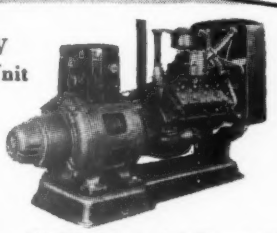

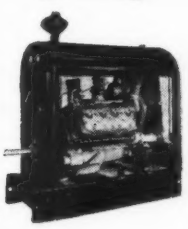

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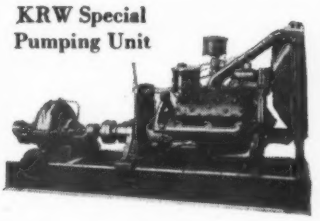

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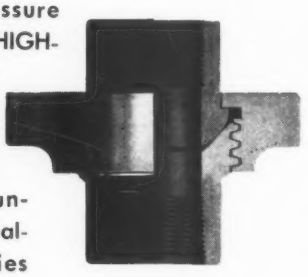

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ter year. Any decline in costs would release funds for expenditures for growth, which has recently been retarded by shortages of steel and other materials.

● **Relation to price.** If we assume that (1) the present price of 36 gravity Mid-Continent crude oil will represent the average for 1948, (2) the American Appraisal Company Index of Construction Costs will average 251 for the year (approximately the level of December, 1947), (3) the 1948 capital expenditures of the 30 oil companies will amount to 2100 million dollars, and (4) the volume of oil processed by the group will increase 5.7 per cent, there is afforded the basis for an interesting approximation; namely, that the present price of $2.57 per bbl for 36-gravity crude oil may be segregated into two components[4], as follows:

Result of rise in costs from 1939 level	$ 0.69
Result of other factors	1.88
Total price	$ 2.57

4. Calculation:

E = estimated capital expenditures of 30 oil companies—2100 million dollars.
C = estimated index of construction costs, 251.
P = price of 36-gravity Mid-Continent crude, $2.57 per bbl.
R = estimated runs to stills of 30 oil companies—1850 million bbl.
X = component of crude oil price represented by rise in construction costs from 1939 level.

$$X = E - \left(\frac{E}{C} \times 100\right) \quad \$0.69$$

$$P - X = \$1.88$$

Therefore it would appear that something like 69 cents per bbl of the current price of crude oil is the result of higher costs involved in capital expenditures.

● **Conclusions.** This study leads to five broad conclusions:

1. The petroleum industry generates out of its own operations most of the capital required for its expansion and is a leading industry in the process of capital formation.

2. The petroleum industry has been retaining a growing share of its net income for reinvestment, the proportion having reached 65.1 per cent in 1947.

3. The petroleum industry will be able to finance its capital requirements for 1948 largely out of its internal capital formation, with an expected smaller recourse to capital markets than in 1947.

4. Of the 1947 capital expenditures of the 30 oil companies aggregating 1.95 billion dollars, 57 per cent, or approximately 1.11 billion dollars, represent expenditures resulting from the rise in construction costs from the 1939 level, including some technological changes such as deeper drilling.

5. Of the current price for 36-gravity Mid-Continent crude oil of $2.57 per bbl, we estimate that 69 cents, or 26.8 per cent, represents the component of the price reflecting the rise in construction and technological costs from the 1939 level, while $1.88 represents the part of the price resulting from other factors.

* * *

NEWS

Small Firms Grow Faster

The "little fellows" in the oil industry are growing faster than the big ones, according to Dr. Joseph E. Pogue, vice president of The Chase National Bank.

A comparison of the net worth of 30 leading oil companies, made by the petroleum department of The Chase National Bank, shows that 13 companies, with net worth of less than $100,000,000 each, increased their net worth on the average by about 63 per cent in the seven years from December 31, 1940, to December 31, 1947. Many smaller companies increased their net worth even more.

The 11 companies of intermediate size, with net worth ranging from $100,000,000 to $500,000,000 grew slightly less than 46 per cent over the same period. The 6 largest of the 30 companies, with net worth of more than a half billion dollars, grew only 14 per cent.

The smaller companies in the group also had higher percentage earnings, the comparison showed.

Standardize Threaded Parts

Representatives of the United States, Canada, and Great Britain met November 18 to formalize an agreement standardizing the threads of ordinary screws, bolts, and other threaded parts.

Since 1943—when the problem of standardization was given impetus by the war — a number of distinguished automotive engineers have been working with the American Society of Mechanical Engineers and other member groups of the Sponsors Council of the U.S.-U.K. on the Unification of Screw Threads, of which William L. Batt is chairman.

Batt, who is president of SKF Industries, Inc., served during the war as vice chairman of the War Production Board. He was shocked as a layman, to discover that British and American gun parts of identical design could not be fitted together because of a difference of five degrees in the angle of threads on their bolts, nuts and screws. This also was true of all vehicles.

To combat this waste of precious shipping space, the official machinery of the Combined Resources and Production Board was set in motion and finally brought about the standardization toward which the Society of Automotive Engineers, the American Society of Mechanical Engineers and other groups had been working.

Tom Alexander and Merwin Vollmer *will be stationed permanently at a new Ideco office in Caracas, Venezuela, states George W. Walton, vice president. These men will accompany Mel Cooper on his various trips in Venezuela during his present sojourn in that country, Cooper being the head technical factory representative. Above are Vollmer, left, Cooper, and Alexander.*

Alexander is a native Texan and an engineering graduate of the University of Texas. During the war Tom was stationed in England as a fighter and bomber pilot with the 8th Air Force. Tom will be accompanied by his wife, Bettye. Merwin Vollmer, also a native Texan, is a graduate of George Washington University, Washington, D. C. A former Marine lieutenant, Vollmer saw action in the Pacific.

Fuel-Saver Released

A new combustion head for use in oil burners has been released by Shell Development Company royalty-free to oil burner makers. It is designed to use with high pressure, gun type oil burners, and is said to reduce the consumption of oil by 25 per cent for the same amount of heating.

Gar Wood Promotes Hiller

Gar Wood Industries, Inc. announces the promotion of R. D. Hiller, Jr. to south central regional manager with headquarters at Tulsa, Oklahoma.

In his new capacity Hiller will be responsible for the activities of all dealers and distributors in his territory handling Gar Wood truck and tractor equipment, Buckeye ditchers and shovels and St. Paul truck equipment plus Gar Wood district managers and field service representatives.

R. D. Hiller, Jr.

Lewis Emanuel Young To Head AIME in 1949

Election of Lewis Emanuel Young of Pittsburgh as president of the American Institute of Mining and Metallurgical Engineers for 1949 was announced at the meeting of the Board of Directors in New York November 17. Young is a consulting mining engineer and has been vice president of the Pittsburgh Coal Company.

Announcement was also made of the election of two vice presidents: Augustus Braun Kinzel, president, Union Carbide and Carbon Research Laboratories, New York City, and Philip Kraft, vice president, Newmont Mining Corporation, New York City.

Four new directors elected were: William J. Coulter, Climax Molybdenum Company, Denver; James L. Head, Anaconda Copper Mining Company, New York City; W. M. Peirce, New Jersey Zinc Company, Palmerton, Pennsylvania, and George P. Swift, Waltham, Massachusetts.

Elected also were six new directors ex officiis as chairmen of professional divisions of the Institute: Frederick N. Rhines (chairman, Institute of Metals Division), Carnegie Institute of Technology; Lloyd E. Elkins (Petroleum Division), Stanolind Oil and Gas Company, Tulsa, Oklahoma; C. D. King (Iron and Steel Division), U. S. Steel Corporation, Pittsburgh; E. R. Price (Coal Division), Inland Steel Company, Wheelwright, Kentucky; Howard A. Meyerhoff, (Industrial Minerals Division), Smith College, Northampton, Massachusetts; S. Joseph Swainson (Mineral Beneficiation Division), Director, American Cyanamid, Stamford, Connecticut.

NEWS

Manhattan Rubber Division Completes Fifty-fifth Year

Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, New Jersey, on October 28, completed its fifty-fifth year.

Manhattan traces its ancestry to the dawn of the rubber industry, to the first chartered rubber company in America, the Roxbury Rubber Company of Boston. It was organized in 1833, six years before Goodyear used sulphur to vulcanize rubber, and in 1845 the Roxbury Company was reorganized by Henry Fowle Durant, founder of Wellesley College, and John Haven Cheever, who became joint owners of the Boston Belting Company and another rubber company. Durant placed his two cousins in the company. One was Frank Cazenove Jones, the other, Col. Arthur Farragut Townsend, godson of Admiral Farragut.

In 1893, Jones, Col. Townsend and George Woffenden, then considered top-ranking rubber expert, founded The Manhattan Rubber Manufacturing Company with a newly built plant at Passaic. Jones became first president but retired in 1903 in favor of Col. Townsend who served as president until 1929 when the company merged to form Raybestos-Manhattan.

Bureau Makes Honor Awards

Fourteen men in the mining industries received Bureau of Mines Certificates of Honor in recognition of their prompt action in saving lives through their knowledge of first aid, Bureau Director James Boyd announced. All were trained in first aid by the Bureau's Health and Safety Division.

Among the 14 Bureau-trained men who received Certificates of Honor were:

Ray Powell, an employe of the Shell Oil Company, Inc., Houma, Louisiana, treated a man for arterial bleeding, burns, and physical shock following a premature blast of explosives on a seismograph exploration barge on July 23, 1948.

James Brown Dodson, Warren Petroleum Corporation, Gladewater, Texas, gave artificial respiration to his wife, saving her life. Fred L. Fender, also an employe of Warren Petroleum, Maud, Oklahoma, controlled the bleeding of a man suffering from hemorrhages, and treated him for physical shock. A. C. Havens, another Warren employe, Oak Grove, Missouri, checked the flow of blood from his wife's leg after an automobile accident.

Fred C. Dixon, Stanolind Oil and Gas Company, LaFayette, Louisiana, gave artificial respiration and restored life to a man who nearly drowned. W. L. Moore, Jr., an employe of The Texas Company, Tulsa, Oklahoma, saved the life of his wife by stopping the flow of blood by digital pressure after she fell on a broken milk bottle and severed her jugular vein. A. P. Charpiot, Sun Oil Company employe, Gilchrist, Texas, gave artificial respiration to a small boy, saved from drowning in the Gulf of Mexico. Awards will be made by the Bureau's Dallas, Texas, office.

Export Quotas Down

Country quotas for petroleum products for the fourth quarter of 1948 were announced by the Department of Commerce through its Office of International Trade.

The increased availability of petroleum products from sources outside the United States has made possible a considerable reduction of the quotas for several countries. The quota for the United Kingdom has been reduced from 3,053,000 bbl in the third quarter to 2,127,000 bbl in the fourth quarter. The quota for France has been reduced from 1,320,000 to 640,000 bbl, and the quota for Australia, from 500,000 to 338,000 bbl.

The total fourth quarter allocation for all countries, not including special projects and undistributed reserve, is more than two and one-half million barrels less than the total third quarter allocation for all countries. This decrease is offset to some extent, however, by a larger undistributed reserve, which has been increased from 1,788,000 bbl in the third quarter to 2,860,500 bbl in the fourth quarter.

The Happy Company, *Tulsa, Oklahoma, held its annual sales meeting in October. During the three-day session, district managers and representatives from Illinois, Kansas, Oklahoma, and Texas discussed ways and means first of better serving the producer, said Paul E. Mahaffey, president. Boston Woven Hose and Rubber Company representatives addressed members of the company during the session.*

The Happy Company has grown from its inception in 1920 as the Happy Belting Company, to the present widespread organization covering the Mid-Continent region of the United States.

A recent Happy contribution involves a new product, a mechanical engine starter composed of a friction pulley, bearings, shaft, sheave, V-belt drive and a small air-cooled engine.

At the meeting were, back: Cotton Rundle, district manager, Seminole, Oklahoma; J. B. Allen, Salem, Illinois; Charles Kitch, district manager, Wichita Falls, Texas; Francis E. Rhoads, district manager, Salem, Illinois; Ed Allan, district manager, northern Oklahoma; E. L. "Bus" Williams, district manager, Wichita and Ellinwood, Kansas; John Ritter, sales engineer, Odessa, Texas, and "Tex" Theobald, district salesman, Odessa, Texas.

Front: Ben Shelton, district manager, Kilgore, Texas; Leo C. King, vice president and sales manager, Tulsa; Paul E. Mahaffey, president, Tulsa; Bill McCracken, district manager, Odessa, Texas.

NEWS

F. G. Cottrell Dies

Dr. F. G. Cottrell, former director of the Bureau of Mines, who died at Berkeley, California, on November 16, was one of the best known American scientists, James Boyd, director of the Bureau of Mines, said recently. The electrostatic methods he invented for clarifying air and gases and for breaking emulsions of water in petroleum proved so important that his name is as well known to industrialists as to scientists. He joined the Bureau of Mines in 1911 and was appointed director in 1920. In 1935 he set up an independent research institute, known as Research Associates.

Promotes Modern Lab

Trebor B. Morris, recently appointed chief metallurgist of the American Iron and Machine Works Company, Oklahoma City, is largely responsible for the fact that this company now has one of the most modern laboratories in the Mid-Continent

Trebor B. Morris

area. The laboratory is equipped for the purpose of controlling the quality of the steel and the physical properties of the manufactured products.

Morris acquired his metallurgical training at the Texas College of Mines at El Paso, and seven years in Old Mexico with American Smelting and Refining. He developed a laboratory that was considered the most modern research mining laboratory in Mexico. In 1937 Morris became associated with Reed Roller Bit Company of Houston, as research metallurgist and supervisor, which association continued for 10 years, until his appointment with the American Iron and Machine Works.

Standard Jersey Acquires Middle East Holdings

Standard Oil Company (New Jersey) said that as a result of the recent settlement of two legal actions involving shareholders of the Iraq Petroleum Company (IPC), Standard Jersey will acquire early next month a 30 per cent stock interest in Arabian American Oil Company.

Pending settlement of the IPC suits, an agreement was reached with Arabian American in March 1947, whereby Standard Oil Company (New Jersey) guaranteed $76,500,000 of bank borrowings by Arabian American. With acquisition by Standard Oil Company (New Jersey) of stock in Arabian American, the purchase payment will be used to retire the loan.

The stockholders in Iraq Petroleum Company are the Near East Development Corporation (owned jointly by Standard Jersey and Socony-Vacuum); the Anglo-Saxon Petroleum Company, Ltd; Compagnie Francaise des Petroles; D'Arcy Exploration Company, Ltd.; and Participations and Investments, Ltd.

On July 31, 1928, the five stockholders signed an agreement to work together in exploring the oil resources within most of the area of the old Ottoman Empire. Last year legal actions were instituted in the English courts to resolve doubts that arose after World War II as to whether the 1928 contract, known as the "Red Line" agreement was still binding on the participants or had been dissolved. The settlement, satisfactory to all parties, consisted solely of the liberalization of the 1928 agreement.

Steel Mill Opened

The official opening in October of the new cold reduction sheet and tin plate mill at the Pittsburg, California, plant of Columbia Steel Company, western subsidiary of United States Steel, marks the addition of more than 300,000 net tons annually to the supply of quality steel products made by West Coast steel plants.

Inauguration of this mill, the newest and most up-to-date of its kind in the country, is important in the program of additions and improvements launched by USS after V-J Day, which involves an expenditure program of more than $130,000,000 in the West and in excess of $850,000,000 by USS throughout the whole country.

Upon completion of the current conversion of the Geneva, Utah plant to peacetime output, the Pittsburg, California, plant will receive hot rolled coils of semi-finished steel from Utah for processing into cold rolled sheets and tin plate.

H. T. Price *R. W. Gardner*

New Accounts

Announcement of new accounts to be handled by The Gardner Price Company, Tulsa, Oklahoma, was recently made by Harley T. Price. This sales organization was incorporated last May with Ralph W. Gardner as president and Price as vice president.

A graduate of Oklahoma A&M College, Gardner was formerly sales manager for Braden Steel Company in Tulsa. Price, a graduate of Kendall College, now the University of Tulsa was Tulsa district manager for the Murphy Diesel Engine Company.

The Gardner Price Company is now manufacturer's agents for the S. Morgan Smith Rotovalve Company, the King Tool Company on their pneumatic starter for internal combustion engines, the Mason Measure Meter and the Mason Well Shock Absorber and the Oshkosh Motor Truck's All Wheel Drive Hauling Unit.

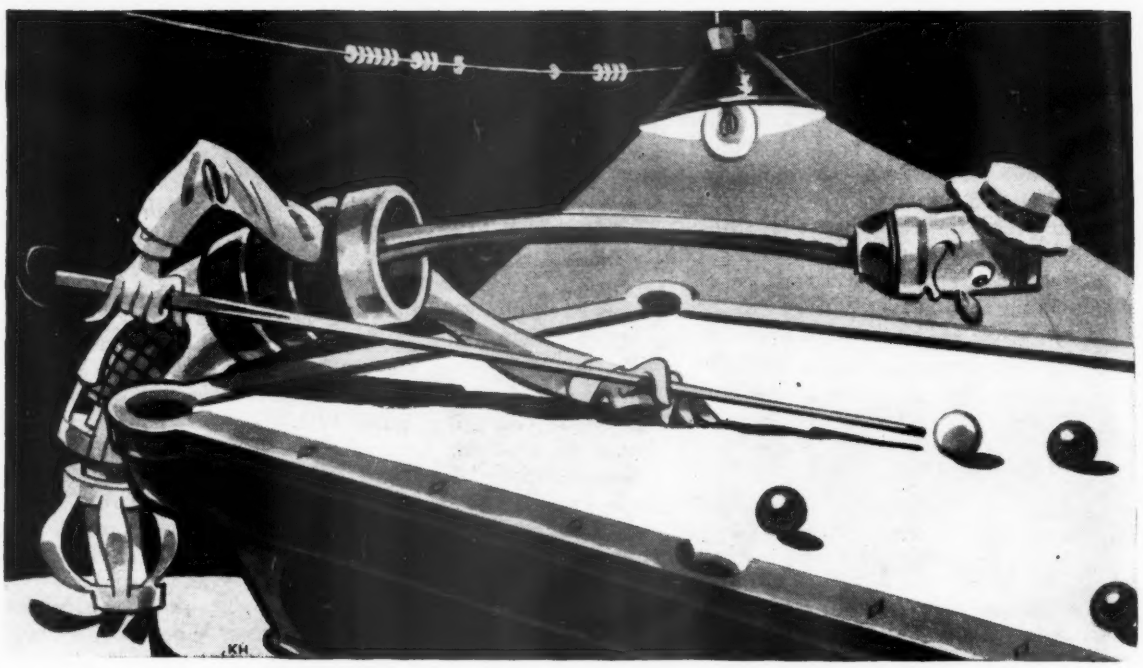
Army Reserve Units

Four Organized Reserve Corps units are being established by Socony-Vacuum Oil Company, Inc.; composed of specialists to aid in handling petroleum problems in the event of war, it is announced. Organization and training are under the direction of J. H. Wright, Passaic, New York, chairman of Defense Services Committee, API, for Area No. 1, of New York, New Jersey, and other states in the region. H. A. Herriman of Socony-Vacuum is in charge for the company. The four units are: Chemical Smoke Generator Company, under H. J. Schroeder; QM Petroleum Base Laboratory, under John McHale; QM Gasoline Supply Company, under Paul Snyder, and Reserve Military Intelligence, 26 Broadway, New York.

Increases Vacations

President L. F. McCollum, Continental Oil Company, announced that, effective with the year 1949, Continental employees not represented by a bargaining agent and who have completed 25 years of service will be eligible for annual vacations of four weeks.

When a Long-Stroke Valve Is Necessary..



... as in deep wells, when tubing stretch is considerable, Lane-Wells BOCL Packer gives the kind of performance that brings pleased smiles to the operator's face. BOCL's long-stroke valve—a full 30 inches—gives perfect control without danger of unsetting the packer when picking up the tubing. You can count on the BOCL to pack off completely when you set it, to release freely when you pull it, and to give you long service. In addition to its long-stroke value it has all the proved Lane-Wells Packer features—Flopak Valve Seal, Floseal Packing Unit, Dovetailed Slips with cross-cut wickers, generous by-pass area for fast running in fluid. Ask your Lane-Wells representative to show you how all these features add up to better packer performance for you.

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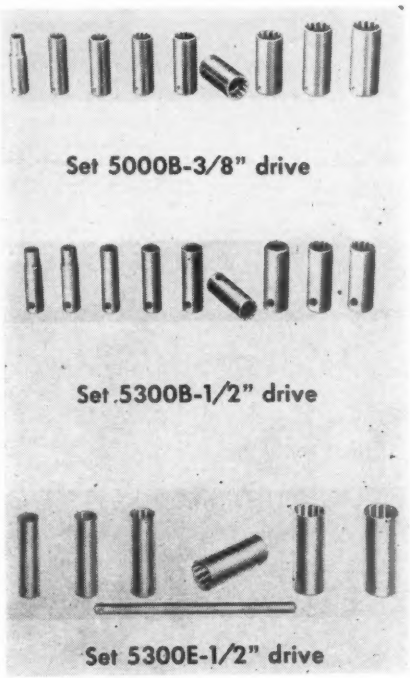
(1) Proto Deep Socket

Addition of three more extra deep socket wrenches and three deep socket sets has been announced by the Plomb Tool Company. The three new 12-point Proto sockets— Nos. 5012, 5026 and 5028—are for 3/8-in. drive and



have opening sizes of 3/8-in., 13/16-in. and 7/8-in., the last two being needed for spark plugs. No. 5000B includes these three sockets and the other six deep sockets available in 3/8-in. drive. The other two Proto sets developed are in 1/2-in. drive. No. 5300B, for general utility work, includes nine 12-point deep sockets. No. 5300E, a spark plug set, includes a pin handle and six deep sockets, with openings of 5/8-in., 11/16-in., 13/16-in., 7/8-in., 15/16-in., and 1-in.

(2) Large Chamber Gage

A new large chamber gage that the manufacturer says gives an accuracy of level reading never before possible is now offered for the first time by Jerguson Gage and Valve Company for use in gaging liquids that boil, where the liquid fluctuates rapidly in the glass.

In making the announcement of this new gage, James Ford, Jerguson sales manager, points out that it represents an important step forward in increased efficiency and safety. As ordinary gages cannot give sufficiently accurate readings when boiling and surging action is present, Jerguson has designed the large chamber gage to hold disturbance of the meniscus to an absolute minimum, he states. The gage chamber has been built to such large diameter that the effect of the boiling action and fluctuation on the liquid level is minimized. This allows close level readings, the kind of readings that are needed for safety and accurate control.

The gage is indicated for use on light end services. It is also valuable as a visual standpipe. The Jerguson large chamber gage, according to the company announcement, is of the flat glass, reflex type, and is made in sections up to any desired length, in multiples of the standard Jerguson No. 7 Reflex glasses.

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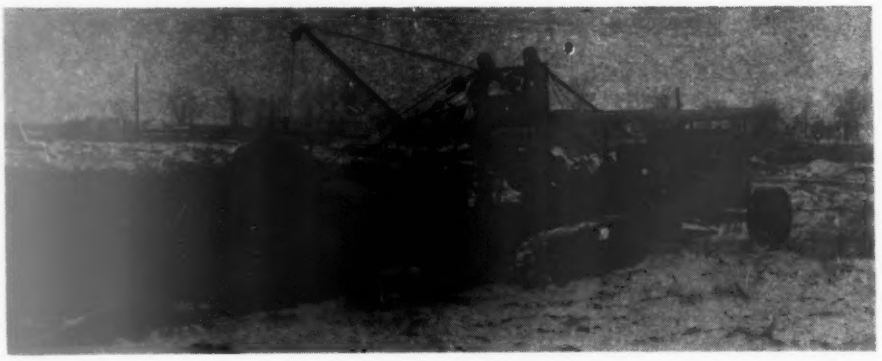
COMPANY NAME.....

STREET ADDRESS.....

CITY..... ZONE NO..... STATE.....



(3) Heavy Duty Pipe Line Ditcher

Built for heavy duty pipe line construction, the new Buckeye Model 51 ditcher is the successor to the famous Model 48 of Gar Wood Industries, Inc., Findlay Division. It cuts a smooth level ditch 51 in. wide and 8 ft 6 in. deep.

A heavy duty constructed frame supports chain-driven digging wheel when roading. The shoe-post supports the weight of the digging wheel when ditching. This insures smooth bottom, level ditches for accurate pipe laying.

Self-cleaning, non-clogging, shovel-type crawlers provide ample traction and anchorage.

In the event of power stoppage on grades, automatic safety brake holds the ditcher until power has been restored.

Plenty of power for digging in all types of soil, is provided by a 110-hp diesel engine. The new Buckeye Model 51 ditcher has ditching speeds ranging from 1.27 to 35.0 fpm. Forward or reverse roading speeds are 1.9 mph.

(4) Valves

Highlight of the new 300-psi bronze globe and angle valves now offered by The Fairbanks Company is the interchangeability of the disk-and-seat combinations for full portway (2 types) and throttle portway use.

The three types include either heat-treated stainless steel plug disks and seats of approximately 500 Brinell hardness or nickel alloy radial disks and seats, while all three are constructed with back-seated rings having a pressure-tight joint between seat ring threads and line pressure. In the body, ribs support stressed areas. In the stem, the special alloy has increased resistance to corrosion, abrasion, and distortion. Solid bonnet contact is a certainty with at least five threads engaged at all times. The line contact formed by the radial bonnet-to-body joint remains pressure-tight constantly. Canting and cocking of the disk are prevented by the improved below-the-shoulder position.

For regular service, the nickel alloy radial disk and seat is available for service up to 300-psi pressure where throttling is not required but pressures and operating conditions tend to shorten valve life.

For severe operating conditions where some throttling is required the full-port stainless steel plug disk and seat is suggested as it has a longer contact area.

For most severe service the throttle-port stainless steel cone-plug disk is recommended, where constant throttling is required. This construction allows 75 per cent of full flow. Disk and seat contact is double that of the full-port type, diffusing the stream and reducing "wire drawing" and wear.

Angle valves are available with the same combinations as globe valves—eight sizes from ¼-in. to 2-in.

(5) Agitator

The Engineering and Construction Division of Koppers Company, Inc., announces it will furnish the Goldman agitator for chemical or other industrial plant installations.

The agitator is so constructed that it propels liquid to the sides of the tank and upward. At the top, the liquid is drawn to the center where it is pulled downward through the hollow axis upon which the agitating blades are fastened. It is expelled from the bottom of this hollow axis to repeat the process.

Several installations of the Goldman agitator are now being made. Through its use, plants will be able to handle production with fewer washers or washers of smaller size.

(6) Bearing Eccentricity

Another of the "practically unheard of" bearing achievements of the Kaydon Engineering Corporation, is holding eccentricity within 2/10,000ths (0.0002) of an inch on giant bearings the outside diameter of which is more than 6 ft, according to an announcement by the company. Even in this organization that makes precision bearings as big as 10 ft OD, such control of eccentricity is something everyone at Kaydon is justly proud of.

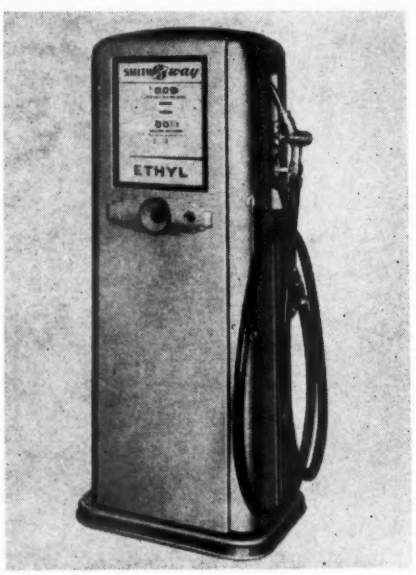
Every operation in the production of these special 4-point contact radial ball bearings, 71.500 in. by 74.500 in. by 2.000 in., is controlled within the Kaydon organization. One of the major factors in holding eccentricity within 0.0002 in. is the unique, super-precision grinding process on huge Frauenthal Precision Grinders. These are the world's largest super-precision grinders, designed to assure extreme accuracy in flatness, squareness, concentricity, roundness, and taper in angular work.

This variety of successful bearing creations embraces all types of ball and roller bearings from 4-in. bore to 120-in. OD.

(7) Smithway Pumps

The Smith Meter Company, which recently purchased the gasoline dispensing pump business of the Neptune Meter Company, has announced that it is establishing sales and service on their new line of Smithway gasoline pumps.

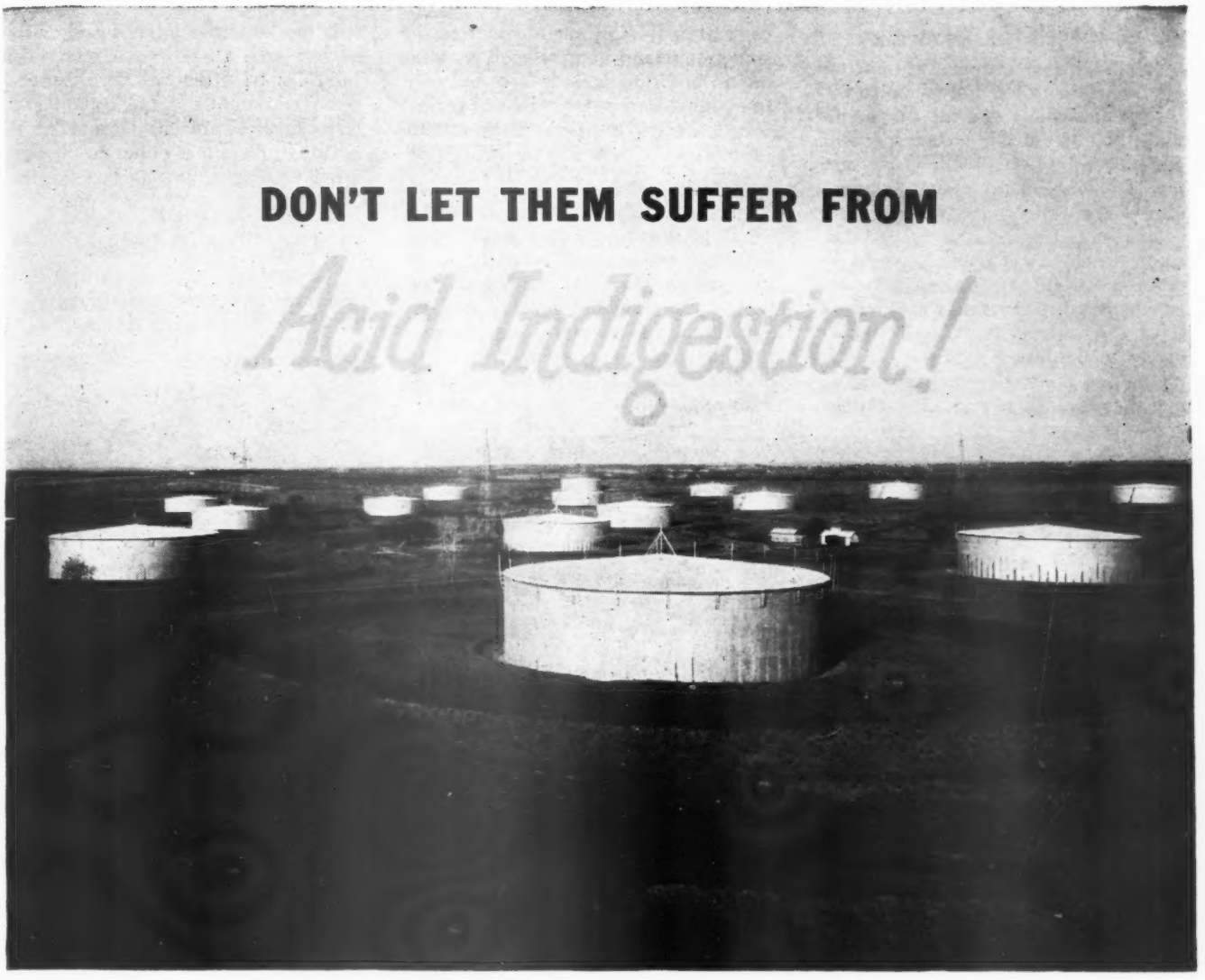
Three models of pumps are available—the L-1, low model with hose reel, the L-1-D, low model with retractable hose, and the H-1, a high



model with standard hose. Each is offered in both computer and non-computer types.

The new Smithway pumps have been particularly designed for simple servicing in the field. This coupled with the Smithway unit replacement plan further lowers the operating costs of these units and makes them most economical from a maintenance viewpoint.

DON'T LET THEM SUFFER FROM *Acid Indigestion!*



Stop "sour crude" corrosion of your field storage tanks before it starts . . . with tough, long-lasting coatings based on VINYLITE Brand Resins. They are resistant not only to sulphuric acid in oil, but to sulphur fumes, salt water and HCl as well.

And this has been proved: As interior coatings on oil tanks and on pipelines containing sour crude of West Texas, these coatings are in excellent condition after two years' service. Over 85 per cent of other coatings were completely destroyed.

Exhaustive tests have proved that VINYLITE Resin coatings withstand the deteriorating effects of such corrosive chemicals longer than any previously used finishes.

Far more than the cost of frequent refinishing is saved. The coating film remains *intact* despite long service . . . maintaining its integrity and bond. Costly metal corrosion is averted.

VINYLITE Brand Resin coatings are equally effective for metal or concrete tanks, not only protecting the tanks from chemical attack, but protecting the contents of the tanks from contamination by the tank materials.

Tough, long-lasting coatings of VINYLITE Resins have also proved their superiority on oil well casing and sucker rods, and in chemical process tanks of many kinds. Resistant to nearly all chemicals, they even withstand, for short periods, temperatures as high as 300 deg. F. For detailed technical data, and information on suppliers of VINYLITE Plastic Coatings, write Department DW-57.

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RESINS

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.

(8) Low Voltage Controllers

A new line of low-voltage controllers for use with a-c motors up to 800 hp (at 550 volts) and for d-c motors up to 350 hp (at 230 volts), has been announced by General Electric's Control Division. These new metal-enclosed controllers are designed for controlling squirrel-cage, wound-rotor, synchronous, or multi-speed d-c motors. Common applications for which they are desirable are pumps, mixers, grinders, mills, and similar drives in the heavy industries.

The new controllers are unusual in that they include in one unit only the conventional equipment required to start, stop, and control such motors, but in addition include a completely integrated draw-out air circuit breaker that provides adequate short-circuit protection (either 25,000 or 50,000 amp).

Serving also as a circuit isolating device, this draw-out air circuit breaker is designed so that it is readily interchangeable. Therefore, when one is removed for servicing another may be substituted immediately, thus preventing lengthy production delays. In addition, when the breaker is pulled out to the inspection and test position, it is mechanically latched and disconnected from all power. A mechanical interlock trips the breaker when it is removed from its unit. Mechanical interlocks also prevent closure of the breaker unless it is either in the operating or inspection and test position.

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The Arcco-Anubis Portable Gas Balance is a fine Specific Gravity measuring instrument of laboratory accuracy, yet ruggedly designed for field use. • It is quickly set up and easy to read. There is no vacuum pump or other complicated accessories. Thermometer is mounted inside and completely submerged in gas sample. • The critical points are made heavy, strong and corrosion resistant while the over-all weight has been kept to 12 pounds. (With carrying case, 20 pounds)
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(9) Line Blowoff Device

An unusual device designed to eliminate to a great extent the manual effort connected with the purging of

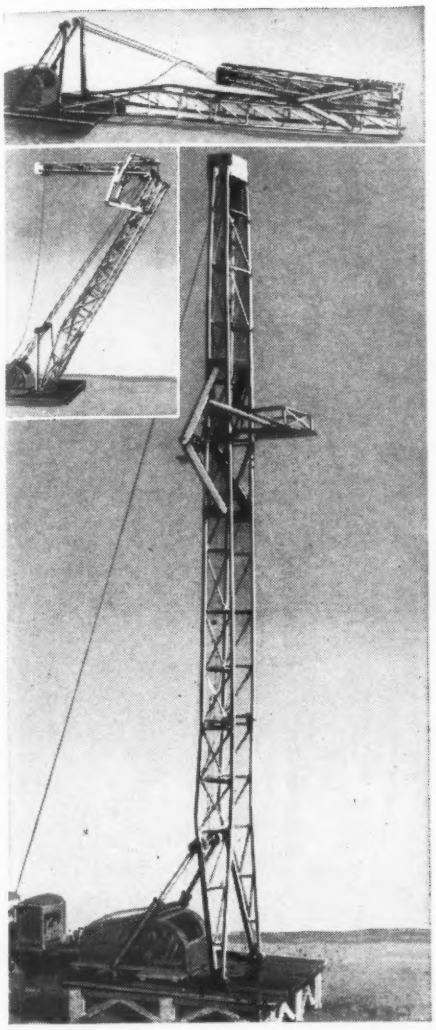
gas transmission lines, has been developed by United Gas Pipe Line Company. The apparatus incorporates a stock blanking plug having one or two fastening bolts instead of the customary number of eight or more. The patented features of the apparatus facilitate ease of operation by one workman.

Salient features include:

1. Cylindrical cam for readily disengaging the interrupted thread fastening of the blanking plug.
2. Plate cam for raising the blanking plug.
3. Thimble and ring supports for closure cap.
4. Safe and protective support for gasket and contact surfaces. Cap cannot be misplaced or damaged although it has the required freedom for opening and closing operations.
5. A large number are presently used by a major gas transportation company.
6. Specification—ASA ratings for specified pressure requirements. Moving parts are stainless steel or otherwise protected from atmospheric exposure.

(10) Jack-Knife Derrick

Franks Manufacturing Corporation announces the design of a new double jointed, 130-ft, thribble, jack-knife derrick with 16-ft base. It can be folded into



a single load for off-set or location-to-location moving, complete with lines and block strung and ready for immediate erection at new location. For over-highway moving, the Franks derrick folds into two parts, each section making a single truck load. The Franks model is the first derrick of the 130-ft size to afford unit portability, the manufacturer states.

Features include: pipe racking board that never has to be removed, design that eliminates guy lines, derrick that does not have to be snubbed with winch truck or lines, use over any drawworks, and traveling block hook and drilling line that are strung up at all times and are used to raise and lower the derrick through power of drawworks.

(11) Plastic Pipe

A new corrosion-proof plastic pipe has been developed by United States Rubber Company for use in chemical manufacturing, mining, and other industries. The pipe is made of the company's new Kralite, a blend of synthetic rubber and thermoplastic resins. It will be supplied in rigid and semi-rigid forms in sizes ranging from ¼ to 2 in. OD. It may be bent to various radii and threaded for fittings.

The pipe is made by a continuous extrusion process. Raw materials are put into one end of an extruding machine and finished pipe comes out the other end. No metal or fabric reinforcement is used in the construction.

(12) Powder-Actuated Driver

Mine Safety Appliances Company has recently developed a powder-actuated driver that will "pin" a pipe hangar to a concrete ceiling or wall, steel I-beam or column, in a few seconds. It also fastens wood to concrete or steel.

Two diameters of studs—⅜-in. and ¼-in.—may be used by interchanging the barrels of the tool. There are several varieties of studs available—externally or internally threaded or plain, headed types.

Operation of the five-pound tool is simple. The stud, with the cartridge attached to it, is inserted in the barrel. The operator then rotates a spring-loaded safety arm 180 deg to move the firing pin into position for contacting the cartridge primer. Holding the barrel against the material to be penetrated, the tool is pushed forward sharply to discharge the stud.

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. . . are "run-of-the-mill" for FALSTROM engineers. This assembly of 5 large cubicles is approximately 40 feet long by 10 feet high, built of ¼ inch steel plate. Ingenious unit construction makes handling, shipping and carrying through doors and elevators an easy matter—while permitting quick erection at site by unskilled labor.
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(13) Tube Expanders

Two newly designed self-feeding tube expanders with ball bearing thrust are being introduced by the Airetool Manufacturing Company. They are known as the G-800 and G-1200 tube expanders and are for precision rolling of condenser and heat exchanger tubes of ½ in. OD to 1½ in. OD. They are especially effective in rolling bi-metal tubes and for use in thick tube sheets, it is stated.

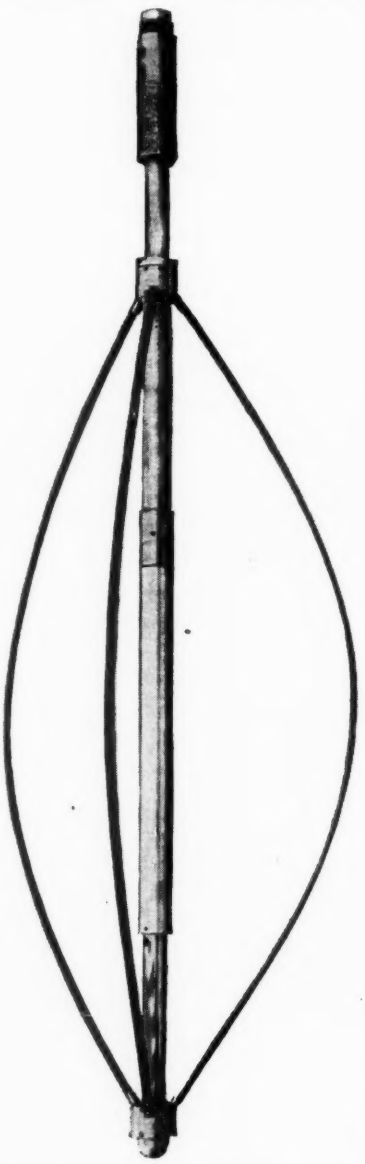
A feature of these expanders is the adjustable ball bearing thrust collar and mechanism, which eliminates cage friction and results in smoother rolling operations and longer life.

During operation the adjustable ball bearing thrust collar of these expanders remains stationary against the tube end and the thrust load is transmitted to the ball bearings.

Like all other Airetool expanders, the G-800 and G-1200 are self-feeding and parallel rolling. The fine grained, heat-treated rolls are tapered to produce a uniform expansion that tightens the tube throughout the entire thickness of the tube sheet. The front of the rolls has a long, gradual radius that does away with any possible ridging that sometimes occurs when rolls with a sharper radius are used.

(14) Open Hole Gauge

The new Schlumberger open hole section gauge was specially designed to meet a need for an accurate hole gauge of substantial construction that could



be run either up or down a drill hole without hanging up

The Schlumberger gauge is designed to produce at the surface an electrical recording of hole size in terms of cross-sectional area. The volume of the hole can be quickly and accurately determined by measuring the area enclosed by the curve with a planimeter.

Hole diameter may be obtained by reading the log curve with respect to a graduated diameter scale located at the bottom of the chart heading.

The instrument is run into the hole on the same cable used for electrical logging, and the log of the hole is available at the well upon conclusion of the survey. The time required for surveying a given interval of hole may be based on a running speed of approximately 6000 ft per hr. The springs on the instrument when expanded to their greatest arc will correspond to a hole diameter of 36 in.

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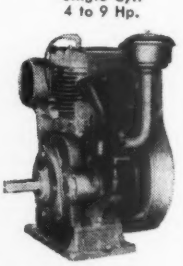
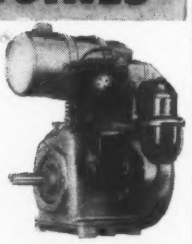
If you build or use any kind of equipment that is or that CAN be successfully engine-powered — there is a fairly definite certainty that you can actually increase the productive capacity of the machine by motorizing with a Wisconsin Air-Cooled Engine.

This rather broad statement is predicated on the fact that Wisconsin Engines are notable for continuous, high ratio power output as well as an absolute minimum of maintenance and servicing layups. In addition to the basic advantages of air-cooling, light weight, compact design and all-weather serviceability—you are assured of "Most H.P. Hours" of on-the-job operation, thanks to advanced engineering and heavy-duty design and construction.

Wisconsin Engines are worth looking into on all counts. Your interest will be heartily reciprocated.

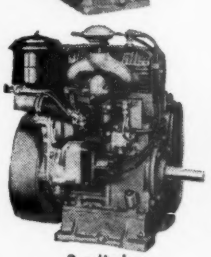
Single Cyl. 4 to 9 Hp.

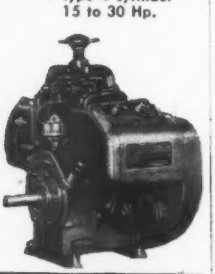




Single cylinder 2 to 5 Hp.

V-type 4-cylinder 15 to 30 Hp.





2-cylinder 7 to 13 Hp.

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Onan standby electric plants, made by D. W. Onan & Sons, Inc., of Minneapolis, are widely used to protect business, hospitals, theaters, public buildings, farms and homes against costly powerline failures. With reliability of top importance on such jobs, Ford Industrial Engines are standard on many Onan models. Pictured is a 10,000 watt model powered by the Ford 120 Four Cylinder Industrial Engine.

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Ford 120 Four Cylinder Industrial Engine (120 cu. in. displacement)

Ford Get acquainted with the new Ford "Power-Family" . . . five great industrial engines—a "four" of 120 cu. in. displacement . . . two "sixes"—226 cu. in. and 254 cu. in. displacement . . . two "eights"—239 cu. in. and 337 cu. in. The *right* power for you, and every one completely new! Send post card today for full specifications and—for power, pick Ford!

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(15) Hydraulic Cylinders

Ledeen Manufacturing Company is now in preparation of a series of information sheets illustrating varied uses of hydraulic, oil or water operated actuating cylinders. These sheets will be finished and released throughout the coming year and will be of interest to readers.

(16) Fireboxes for Domestic Oil Burners

The Babcock & Wilcox Company announces the publication of a new edition of the B & W Firebox Handbook on the design and construction of modern fireboxes for domestic and small commercial oil burners. This compact handbook offers essential information on the selection of suitable materials and the designing and installation of fireboxes for trouble-free and economical heating. Since its first edition in 1946, close to 30,000 copies have been requested by oil burner men.

The latest edition of the Firebox Handbook has been expanded to give data on certain commercial installations as well as to cover the special problems arising from the heating of the smallest homes. The manual points out that modern small, well-insulated homes often have firing rates of less than 1.0 gph and that many difficulties arise with nozzle plugging, strainers, etc., which require careful engineering.

(17) Pneumatic Transmitters

Republic Flow Meters Company has released their Data Book No. 1001 covering pneumatic transmitters. This bulletin contains complete, up-to-date information on Republic pneumatic transmitters and their application to the measurement of flow, level, pressure, and density.

(18) Prevention of Corrosion

The Power Chemicals Division of the E. F. Drew and Company, Inc., is offering a four-page illustrated booklet describing the action and application of their product used for the prevention of corrosion in steam lines, condensate lines, and plant equipment. This material is not an amine and therefore is economical to use, at the same time being non-toxic. A method of determining the corrosiveness of steam is also covered.

(19) Pressure and Vacuum Gauges

In the new catalog "Pressure and Vacuum Gauges" published by the Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company, attention is called to the full and complete descriptions of the various instruments such as indicating and recording pressure gauges, recording flow meter and pressure gauge, air-operated controller, non-indicating pressure controllers, indicating furnace pressure controller, precision pressure regulator, etc.

Also featured in Catalog No. 7000 are pressure-actuating elements, high vacuum gauges, control components (including Electr-o-Vane electronic controller); the Air-O-Larm system, the integral control by-pass and liquid level measurement of open and closed vessels.

The catalog is well illustrated throughout its 31 pages with clear schematic drawings, photographs, and diagrams and also includes pressure range charts and indicating scales.

(20) Drill Pipe and Tool Joints

Spang-Chalfant Company has printed a new bulletin on Spang double seal shrink thread drill pipe and tool joints. It describes in detail the improvements recently made in the joint.

There are now two distinct seals—one internal and one external. The machining accuracy of these seals may well be described in superlatives, the company states. Such accuracy is important but the inherent value of the joint lies in its shrink fit. To assure the accuracy of the shrinking operation and to facilitate this operation in the field, the pipe is factory marked for proper positioning.

The combination of accurate machining and equally accurate shrinking to pre-determined factory positions means that every double seal joint develops exactly the same amount of "grip" as the next one. It insures against creepage and washouts.

(21) Aircomatic Process

The Air Reduction Sales Company has announced the availability of a six-page folder entitled "The Development of the Gas Shielded Metal Arc Welding Process." Written by Jesse S. Sohn and A. N. Kugler and presented as a paper before the annual meeting of the American Welding Society, the article gives complete details and description of the new Aircomatic process, which was introduced to industry at the National Metal Exposition.

(22) Conductivity Control

pH and conductivity control and their application to different industrial processes is a feature of the new catalog published by the Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company. Typical examples presented include pH control in heavy chemical industries, agricultural chemistry, electroplating, pulp and paper, research, food, and steel industries; conductivity control in water treatment, power plants, and the textile industry.

Fully illustrated with photographs and schematic drawings, "pH and Conductivity" includes in its 43 pages a partial list of circular and strip charts and scales and dimensional diagrams of pH equipment.

(23) Oil Country Pumps

To aid in the selection of the proper type and size pump for the many different oil country pumping services, a 24-page handbook in a convenient pocket size has been prepared by Marlow Pumps.

The selection guide first presents information on four basic types of oil country pumps—standard-pressure and high-pressure self-priming centrifugals, diaphragm, and plunger pumps—and outlines their main characteristics.

With the type pump determined, the method of arriving at the proper size pump is demonstrated. A specific and typical oil country pumping problem is diagrammed and worked out step by step. Accompanying this problem are friction tables which are valuable for handy reference in many oil country pumping situations.

On the ten pages following, typical Marlow pumps for oil country use are illustrated and briefly described. The guide also contains a list of important operating hints for self-priming centrifugal pumps—the type most widely used in many oil country pumping services.

(24) Lubricated Plug Valve

Section 5 of Valve Reference Book No. 39 has just been issued by Homestead Valve Manufacturing Company covering the Homestead-Reiser "Self-Seald" lubricated plug valve. It offers general catalog data, descriptions, specifications, and prices on the units, parts, and accessories.

(25) Protective Coatings

A new 4-page bulletin issued by United Chromium, Inc. on UCILON protective coatings introduces latest developments in well-known line of corrosion-resisting materials. In identifying each coating and its proper application, this bulletin points out how, as a component in a "system" of coatings, each makes its special contribution towards greater corrosion resistance and a longer lasting job.

Typical case histories are presented in evidence that such specialized coating systems provide an answer to many serious corrosion problems.

(26) Safety and Relief Valves

Farris Engineering Corporation, manufacturers of safety, relief, and pinch valves, and hydrotorous remote control equipment, has issued a 72-page profusely illustrated book covering complete data and information needed in connection with the installation and use of safety and relief valves.

Unique in this book are triple capacity tables which give water, air, and steam capacities for various nozzle orifice sizes, as well as a new tight vapor sizing chart, which enables the valve user to quickly size a valve.

(27) Boiler System Corrosion

W. H. and L. D. Betz announce a 12-page article discussing the cause and prevention of corrosion in boiler systems. The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulphide, acidity, and physical factors are evaluated. Numerous illustrations, graphs, and tables aid in understanding the article. It is designated as Betz Technical Paper No. 111 and titled "Corrosion: Its Effect in Boiler Systems."

(28) Micromax Recorders

In a 32-page illustrated catalog just issued, the Leeds and Northrup Company lists, for the first time in one publication, their complete line of strip-chart Micromax recorders and controllers for measuring a wide variety of process variables—temperature, speed, gas analysis, electrolytic conductivity. pH, etc.

Called "Micromax Model S—Indicating Recorders and Controllers," this publication gives complete specifications in convenient, tabular form.

(29) Lubricated Plug Valve

H. K. Porter Company, Inc., announces publication of the first edition of their new lubricated plug valve catalog.

Consisting of 16 pages, fully illustrated, and amply provided with dimensional drawings, tables, and descriptive matter, the new catalog covers the complete line of Porter lubricated plug valves.

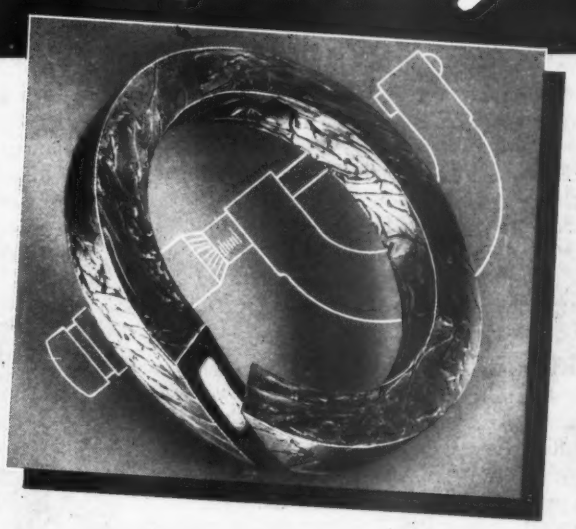
A feature of the catalog is a full-page cross-section view of the valve which, with the accompanying explanation, gives a remarkably clear description of the valve.

(30) Silastic Cable

Dow Corning Corporation has issued a purchase specification, G-6, used in buying Silastic insulated lead cable from their suppliers. This relatively new type of cable retains its flexibility, dielectric strength, and moisture resistance even after continuous exposure to operating temperatures ranging from —70 to 350 F. It has a reasonably long service life at temperatures as high as 500 F.

Because of its exceptional stability, the corporation recommends the use of Silastic insulated cable for wiring ovens and for electrically operated and controlled furnaces, stills, and reactors. Originally developed as a suitable lead wire for Silicone (class "H") and class "B" insulated motors, generators, and transformers, Silastic insulated lead wire has been found useful for power and control wiring in power houses where ambient temperatures are generally high and high humidity is frequently encountered.

DURAMETALLIC Packings



PRECISION made die-molded packing rings by Durametallic present 3 points of sealing satisfaction:

1. They provide a perfect fit for your stuffing box.
2. They save time, labor and eliminate waste.
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WRITE TODAY FOR FILE DMPE . . . Contains illustrated bulletins on Durametallic Packings — with specifications and data toward answering your sealing problems.

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BATON ROUGE, LA. • PITTSBURGH • ST. LOUIS • SALT LAKE CITY
SAN FRANCISCO • SEATTLE • TULSA • YOUNGSTOWN, O.

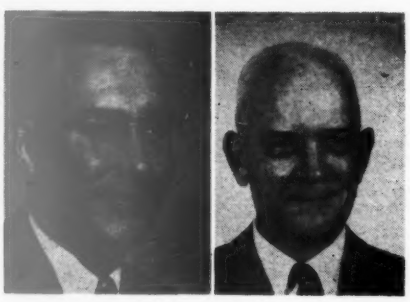
PERSONALS

▸ **Robert W. Schlumpf,** chief metallurgist of Hughes Tool Company received a distinguished service award at the annual convention of the American Society for Metals. The award read "for outstanding work in the utilization of alloy steels in oil-well-drilling equipment."

Schlumpf joined Hughes Tool Company in 1924 and is considered a leading authority in the metallurgical field pertaining to oil-well-drilling metal processing.

▸ **Robert A. Henderson** of Socony-Vacuum Oil Company, Inc., has been elected president of the Metropolitan Traffic Association of New York. Henderson has been associated with the company's traffic department for the past several years.

▸ **Eugene T. Scott,** 35, former sales manager of Templeton, Kenly and Company, Chicago, Illinois, manufacturers of Simplex Jacks, died September 30 at his home in Hinsdale, Illinois. Ill health caused his retirement from active duty with the company early in 1948, although he had continued to serve on the board of directors.



J. D. Anderson *E. W. Shoupe*

▸ **J. D. Anderson** was appointed manager of the purchasing department of The Ohio Oil Company. Anderson, recently division petroleum engineer of the Casper production division, is now in the Company's general office in Findlay, Ohio.

E. W. Shoupe, has been promoted to purchasing agent. **M. E. Loose** became assistant to the manager of the purchasing department.

▸ **Nelson C. Walker** was recently appointed assistant district manager of American Car and Foundry Company's Berwick, Pennsylvania plant. He was president of the United Tank Corporation prior to coming to ACF.

▸ **J. S. Feroe** has been elected president of Beacon Petroleum Company, Tulsa, Oklahoma. The re-election of **H. R. McFarland** as vice-president and secretary, and **R. E. Bolinger** as vice-president and treasurer of the firm was also announced. **E. Q. Beckwith,** former president of the firm, recently joined the Sid Richardson Gasoline Corporation.

K. H. Swart

▸ **K. H. Swart** has been elected vice president of the Security Engineering Company, Inc. Along with his new responsibilities, he will retain his present position as chief engineer. For the past thirteen years he has been with the company and has been active in design and development.

▸ **Charles L. Haslup** has been appointed sales manager of field operations for the Reading-Pratt and Cady Division of American Chain and Cable Company, Inc., with headquarters at Reading, Pennsylvania.

▸ **Cyril Wigmore,** 72, mining and petroleum engineer, died suddenly on November 3 at his home in Los Angeles, California. He was a graduate of the University of California, and had lived in Los Angeles for 60 years.

▸ **Ross Floyd,** Continental Oil Company's agricultural service director, was among the Future Farmers of America founders honored during the 20th anniversary meeting of the national FFA in Kansas City. Floyd, one of the organizers of the Future Farmers of Oklahoma in 1926, participated in forming the national organization which today numbers 350,000.

▸ **Thomas B. Moule** has been appointed sales manager of the Plomb Tool Company, Los Angeles, California. Since joining the company in 1944, Moule has supervised many important sales and merchandising activities.

▸ **C. B. Johnson** has been named chief engineer and **E. R. Gilmore** director of research for The Rockwell

E. R. Gilmore *C. B. Johnson*

Manufacturing Company's Pittsburgh Equitable Meter division.

Johnson joined Rockwell in 1929. He started with the Pittsburgh Equitable Meter Company in 1929 and in 1941 went to the Pittsburgh-DuBois Company. In 1944 he returned to Rockwell.

Gilmore was formerly chief engineer of the meter and regulator divisions of the Company. He joined the Pittsburgh Equitable Meter Company in 1936.

▸ **S. R. Billingsley** has been appointed sales engineer for Aeroquip Sales and Engineering, Inc., Fort Worth. He will specialize in aircraft sales throughout the Southwest.

▸ **A. C. Rall** and **C. F. Salzer** have been made assistants to the comptroller, and **J. F. Tim, Jr.,** has been appointed manager of the general statistical division for Gulf Oil Corporation.

Prior to coming to Gulf in 1946, Rall was employed by Price, Waterhouse and Company. Salzer's service with the Company started in 1930 at the refinery on Neville Island. Tim joined the Gulf Companies in 1927, and since 1936 he has been assistant manager of the general statistical department.

▸ **Walter Dannenbaum** has been elected director, vice president, and member of the executive committee of E. I. du Pont de Nemours and Company. Dannenbaum has been general manager of the company's ammonia department since July of 1946. He has been connected with the du Pont Company since it acquired the National Ammonia Company, of which he was then president, in 1926. He succeeds the late E. B. Yancey, who died on October 24 after a short illness.

▸ **J. T. Gillespie, Jr.** has been appointed sales manager, Watson-Stillman Company, Roselle, New Jersey. **H. E. Elliott** will continue as assistant

J. T. Gillespie, Jr.

sales manager over the railroad, metalworking and general industrial equipment division; **James Wilson** as assistant sales manager in charge of the plastics molding machinery division; and **John P. Bittenbinder** as assistant sales manager directing distributor products sales.

▸ **Conger Reynolds,** director of public relations for Standard Oil Company (Indiana) was elected chairman of the national Oil Industry Information Committee for 1949. He will succeed Ralph C. Champlin, Ethyl Corporation, New York, who headed the Committee in 1948.

▸ **Ray H. Anders** has been appointed director of purchases of Sun Oil Company to succeed **Henry Thomas,** who

R. H. Anders

retires after 36 years of service. Anders will be assisted in his new duties by **Roy A. Hurst,** assistant director of purchases. Anders became associated with the company in 1929.

▸ **Richard C. Lawton** has been appointed district engineer in the territory of Western New York State, with headquarters in Rochester. He represents the bearings division of The Torrington Company.

J. H. Williams is now assisting **L. A. Toth** in the Dallas office as district engineer. Toth has been named district manager of the Dallas office.

J. N. Wholean has augmented the Milwaukee staff as district engineer. **D. E. Lewis** is district manager of the Milwaukee office.

▸ **W. M. Wright,** former bookkeeper at Graham, Texas has been appointed store manager for The Continental Supply Company, replacing **C. A. Ross,** who has been transferred to Wichita Falls as manager. He succeeds **W. R. Everett, Jr.** who has been moved to Pampa, Texas, in the same capacity. The former Pampa store manager, C. T. Wagner, has resigned.

▸ **Hyman Iserson** and **Maurice E. Miville** have been appointed research chemists at its Whitemarsh Research Laboratories it was announced by Dr. W. A. LaLande, Jr., director of research and development, Pennsylvania Salt Manufacturing Company.

Install Them and Forget Them!
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RADIAL
Roller Bearings
AMERICAN RADIAL ROLLER BEARINGS are engineered to exacting standards that result in better performance and minimum maintenance.
Furnished in 5 styles, 6 S.A.E. series and 85 sizes. Special designs also available. Write.
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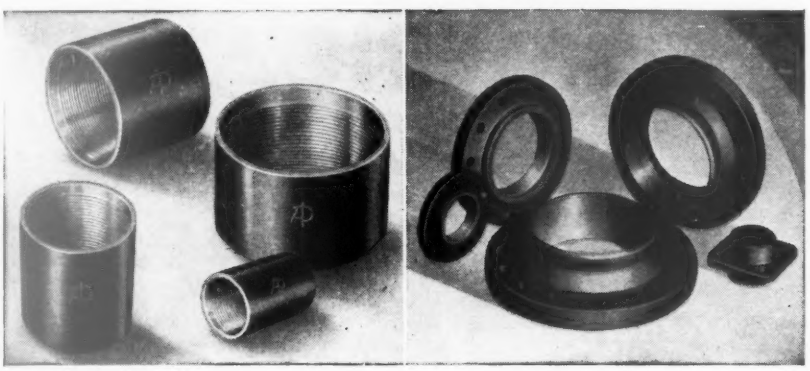
▸ **Victor L. Persbacker** was recently appointed auditor of the American Brake Shoe Company by the board of directors according to an announcement by William B. Given, Jr., president. In addition to his new duties, he will continue to serve as assistant comptroller of the company.

▸ **Charlie Giraud** has been appointed salesman in the Houston District for Cameron Iron Works, Houston, Texas. Giraud has been a member of the Cameron sales department for two and one-half years, having served a total of eight years with the Cameron organization.

▸ **George W. Walton,** vice president in charge of machinery and export division of the International Derrick and Equipment Company has left Dallas headquarters for South America. He will call on Ideco representatives in Caracas, Buenos Aires and Rio de Janeiro.

▸ **William C. Reid** of East Swanzey, New Hampshire, left for an inspection tour of metallizing operations in England in September. Reid, who serves as consultant to the American Metallizing Contractors Association, St. Louis, Missouri, will represent that organization while in England.

HARRISBURG



Oil Field Products

PIPE COUPLINGS

Made to A.P.I. Specifications

Harrisburg Seamless Steel Couplings owe their superiority to almost thirty years experience plus carefully controlled inspection. The accuracy of the threads in a Harrisburg Coupling assures a perfect leak-proof joint. Available in all sizes and types.

PIPE FLANGES

Manufactured to A.S.A. Standards

It is the accuracy of machining that assures the strength and endurance found in all Harrisburg Drop-Forged Steel Pipe Flanges. Threads are perfect in height, angle, taper and gauging. Forged from Harrisburg's own steel and furnished in all types and sizes.

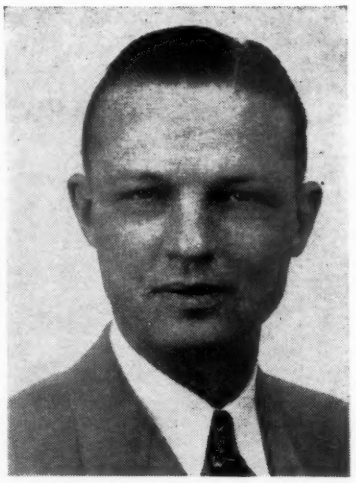
We Make Our Own Steel

Because Harrisburg makes its own steel, complete control of the manufacturing process is assured from open hearth to finished product. Add to this Harrisburg's years of experience in the proper heat treatment of specific products and you have the answer to Harrisurg's superiority in the field.

Send for Complete Catalogs

HARRISBURG STEEL CORPORATION
HARRISBURG, PENNSYLVANIA

▸ **Berney L. Morgan** was made sales representative in the Houston territory for France Packing Com-

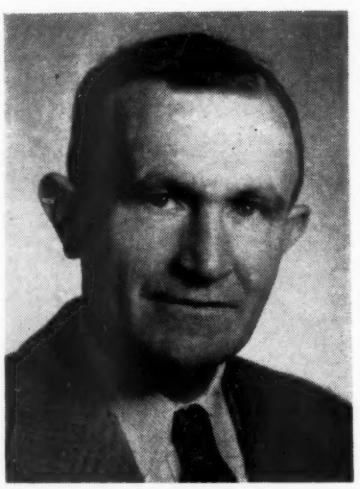


B. L. Morgan

pany of Philadelphia. Morgan will cover the Gulf Coast, Central and East Texas, Louisiana and Southern Arkansas with headquarters in Houston, Texas.

▸ **Charles K. Slack,** assistant treasurer of the General Petroleum Corporation, Los Angeles, California, was elected a vice president of the Tax Executives Institute, at their annual convention in October. In his work Slack handles income, sales and excise taxes for General Petroleum.

▸ **Sam T. Dyer** has been appointed manager of the Gulf Coast equipment

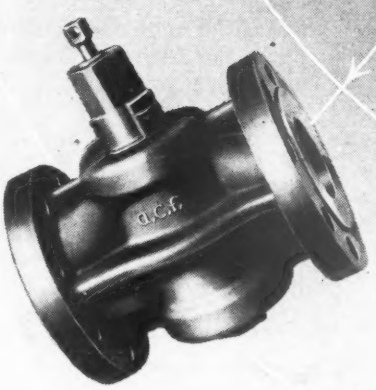


S. T. Dyer

division of Mud Products, Inc., Tulsa, Oklahoma, distributors of drilling muds, chemicals and mud handling equipment, E. R. Albert, Jr., general manager, announced.

▸ **H. E. Johnson** has been appointed sales manager of Alloy Steel Products Company with headquarters at Linden, New Jersey. Johnson was district manager of the Chicago office.

Why anything other than a Cylindrical Plug Valve?



It came into being with modern precision-ground fits... High pressure grease seal... Easy to turn... Always liquid tight.

CYLINDRICAL FULL PIPE AREA LUBRICATED

a.C.f. PLUG VALVES

Representatives in more than 50 Principal Cities

Reference Catalog No. 4-PE of types and sizes available on request. Write American Car and Foundry Company, Valve Division, 30 Church Street, New York 8, New York.

▸ **Howard M. Dawson** has been elected president of Jessop Steel International Corporation according to an announcement by the board of directors. He was formerly vice president and managing director of the corporation.

▸ **Walter D. Binger,** as announced by Robert S. Waters, president, was elected a director of The National Radiator Company, Johnstown, Pennsyl-

W. D. Binger

vania, manufacturers. Binger is vice president of the City Investing Company, and president of the City Construction Company, New York City.

▸ **Arch F. Campbell,** manager of petroleum industry diesel engine sales for General Motors Corporation has left for an extended trip to Europe and the Persian Gulf area. He will visit oil company headquarters and field operations in the area.

▸ **O. E. McCullough, Jr.,** has been appointed district sales manager of Stacey-Dresser Engineering, a member of Dresser Industries, Inc., with offices in the Praetorian Building in Dallas, Texas. McCullough, who studied at Southern Methodist University, and has had experience in oil fields in the Southwest, comes to Dallas from the company's Cleveland, Ohio office.

▸ **Stuart M. Crocker,** president, Columbia Gas and Electric Corporation, has been appointed vice chairman of the committee on promotion, advertising and research of the American Gas Association. The PAR committee evaluates the special needs of the industry in the fields of promotion, advertising and research and determines the amounts of money to be raised through industry subscription for these activities each year and allocates the funds subject to approval.

▸ **Frank T. Ostrander,** vice president in charge of the New York City office of National Supply Export Corporation retired in October after 43 years of service. He will remain, however, with the corporation in an advisory capacity.

Ostrander was educated at Union College, Schenectady, New York, where he graduated in 1902 with a B. A. degree. Upon graduation he went to Pittsburgh, Pennsylvania, where he worked for the former Shelby Seamless Tube Company. In 1905 he entered the employ of the National Supply Company, and was assigned to the export department. In 1917 Ostrander opened the New York office, becoming vice president of the export subsidiary, National Supply Corporation, now the National Supply Export Corporation.

▸ **Fred S. Ehrman,** general sales manager of Bowser, Inc., since 1944, has been elected to the newly created

F. S. Ehrman

post of vice president and director of sales. Ehrman has been associated with Bowser, Inc., since 1925, and has served successively in experimental engineering, sales engineering and divisional sales work.

▸ **D. G. Weekes** has been appointed district manager of tubular sales for the North Texas and West Texas-New Mexico district with headquarters in Fort Worth, for The Continental Supply Company, Dallas.

Weekes has been with the tubular equipment industry since his graduation from the University of Michigan. In 1945 he joined the Youngstown Tubular Division of Youngstown Sheet and Tube Company, soon moving to Texas as field representative. He served in this capacity until his recent employment by Continental.

▸ **M. J. Kirwan, Jr.,** opened a law office in the Midland Tower Building, Midland, Texas recently for general

M. J. Kirwan, Jr.

practice of law. Kirwan was attorney for Cities Service Oil Company at Houston three years, and attorney for Tidewater Associated Oil Company, Houston, three years.

▸ **Russell Runyon** has been placed in charge of purchasing at the Hazleton, Pennsylvania, plant of Oliver United Filters, Inc., manufacturers of industrial filters and pumps. Runyon has had considerable experience with the company's requirements, having been connected with the company's purchasing department since 1936.

▸ **Adrian Van Kampen** has been appointed to Kerotest Manufacturing Company's southwest sales division, with headquarters at Houston, Texas. Van Kampen will cover the territory formerly serviced by Walter Cox. He is widely experienced in the oil business, and for many years was associated with Allis-Chalmers as sales engineer.

▸ **David D. Dellinger,** treasurer and vice president in charge of finance for the Continental Supply Company, Dallas, Texas, recently resigned to accept a position as vice president in charge of finance for Fred M. Manning, Inc., oil well drilling contractors, Denver, Colorado.

A native of Northern Ohio, Dellinger received his B.A. degree from Heidelberg University in 1920. Upon receiving his degree, he entered family business, remaining in that work until 1933, when he joined Continental.

Shortly after he became associated with the supply firm, Dellinger was made assistant treasurer. He was elevated to treasurer in 1940, and to vice president in charge of finance for Continental early this year.

▸ **F. A. Maskell** has been appointed as sales representative of the New York Belting and Packing Company it was announced by B. F. Reuther, sales manager of the company. Maskell will cover the states of Colorado, Utah, Arizona, and New Mexico, with headquarters in Salt Lake City.

▸ **Fred Jobst** left recently for a trip to Venezuela in the interest of the companies represented by Val Wittich,

Fred Jobst

which include S. R. Bowen Company, Emsco Screen Pipe Company, Houston Slush Pump Company, Miller Sand Pump Company, Texas Iron Works, and Wagner-Morehouse. While there Jobst will visit the many fields of the major oil operating companies.

▸ **William C. McAfee** has been promoted to manager of the Oil Well Supply Company store at Mission, Texas, as announced by F. D. Smith, manager of that United States Steel subsidiary's gulf coast division.

McAfee, a native of Trenton, Texas, succeeds Louis C. Hurley, who has joined the production equipment sales department. McAfee received his bachelor of science degree at East Texas State Teachers College in 1936. Shortly after his discharge, in 1946, he was employed by Oilwell as a storeman in the Mission store, the position he held at the time of his new appointment.

▸ **R. L. Koehler,** director of sales for FWD, announced a series of major changes in the reorganization of the FWD Sales Division.

A. E. Johnson, formerly assistant field sales manager, has been named supervisor of government sales. **C. A. Rogers,** who has specialized in fire truck sales for FWD has been named supervisor in this market. Lloyd Scheider, formerly assistant to FWD's general manager Robert A. Olen, has been named supervisor of defense sales.

Roy Peterson, has been named supervisor in the oil field market. **C. C. Cooke,** formerly administrative assistant to the director of sales, has been named supervisor of the order department.

Leo Polzin, formerly field sales manager, has been appointed manager of national accounts. **Stanley Wick,** formerly manager of the order department, has been appointed assistant director of sales in charge of all office domestic sales activity; and **Jack Kelly,** formerly assistant field sales director, has been appointed assistant director of sales in charge of FWD's field organization.

John Battes, who for the past three years has been FWD sales supervisor in northern California and Idaho has been named acting manager of FWD's western sales zone. He fills the vacancy of **Paul Schmidt,** who will shortly be named to an important position in FWD's sales organization.

Howard Collard, formerly sales supervisor in Oregon and Washington, has been named acting zone manager in the southeastern states.

The roof and walls are CORRUGATED TRANSITE*

TO HELP BEAT the problem of corrosion in the above Nitrogen Fixation Plant, engineers responsible for its construction selected Johns-Manville Corrugated Transite—a material with an outstanding record for resistance to highly corrosive gases, vapors and fumes.

Made of two minerals—asbestos and cement combined under great pressure into unlaminated, monolithic sheets, J-M Corrugated Transite cannot rot, rust or burn.

Long recognized as the ideal industrial roofing and siding material, Corrugated Transite comes in large sheets that can be quickly and easily installed on any skeleton-frame structure. It never needs preservative treatment—requires little or no maintenance through the years.

Get all the facts about Johns-Manville Corrugated Transite before you build. Write Johns-Manville, Box 290, New York 16, N. Y.

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"Without This Log we'd have had a dry hole!"

Opelousas, La. [redacted]

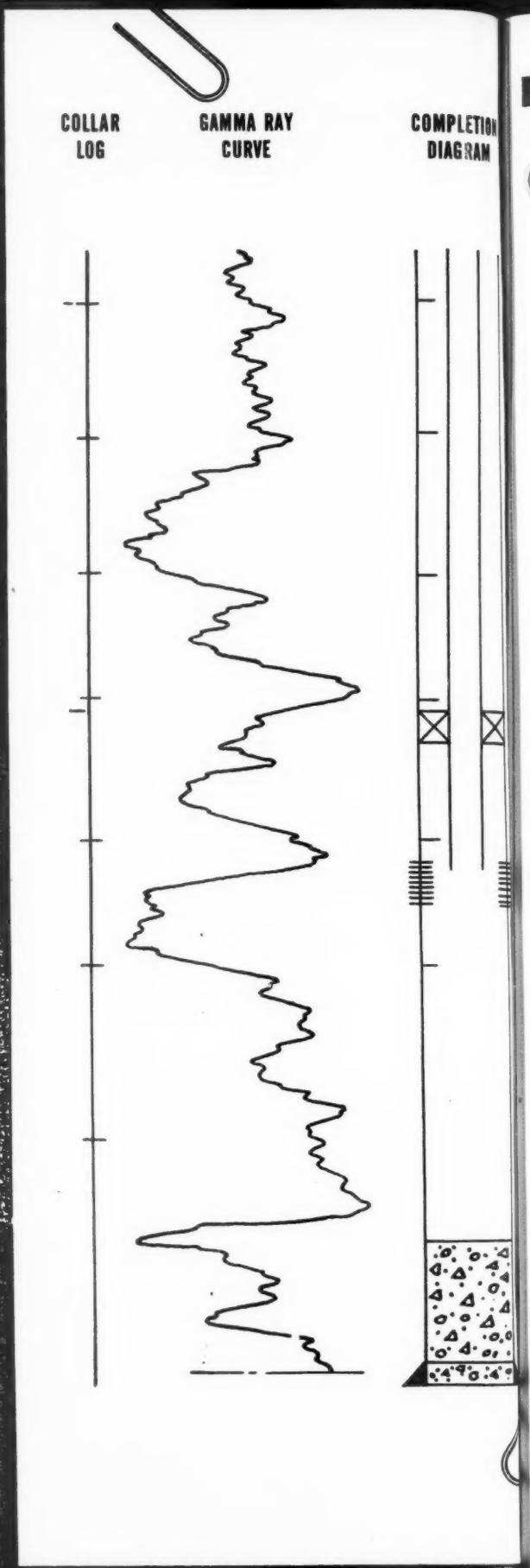
Report on [redacted]

This well had been drilled to contract depth. We were called in because seven electrical surveys did not check with other well measurements.

Ran Gamma Ray and Collar Log Survey to tie down formations to bench marks. Log showed 17-foot measure discrepancy in electrical surveys. Well was gun-perforated accurately from collars, with 72 holes. Completed for an I. P. 210 BOPD, 46.3° gravity, through 1/8" choke.

Operator says, "Without this Log, we would have had a dry hole." Says he is sold on Lane-Wells Radioactivity Well Log from here on.

Signed [redacted]



To be *Sure* of formation depths and characteristics

Run a LANE WELLS *Radioactivity* WELL LOG

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INSTALLMENT No. 138

A valuable and regular feature of *The Petroleum Engineer,* the Continuous Tables, now in their twelfth year of publication, were designed to save time and effort for the technician and the practical field or plant worker. The tables have proved one of the most popular and helpful departments of *The Petroleum Engineer.* Data are presented in the simplest form available with many types of information included that are best presented by curves or nomographs when three or more variables must be considered simultaneously.

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This index will be revised monthly. The index for installments 1-12, inclusive, will be found in the May, 1938, issue; 13-24, inclusive, in the June, 1939, issue; 25-36, inclusive, in the June, 1940, issue; 37-48, inclusive, in the June, 1941, issue; 48-60, inclusive, in the June, 1942, issue; 61-72, inclusive, in the June, 1943, issue; 73-79, inclusive, in the January, 1944, issue; 80-82, inclusive, in the April, 1944, issue; 83-85, inclusive, in the July, 1944, issue; 86-88, inclusive, in the October, 1944, issue; 89-91, inclusive, in the January, 1945, issue; 92-94, inclusive, in the April, 1945, issue; 95-97, inclusive, in the July, 1945, issue; 98-100, inclusive, in the October, 1945, issue; 101-103, inclusive, in the January, 1946, issue; 104-106, inclusive, in the April, 1946, issue; 107-109, inclusive, in the July, 1946, issue; 110-112, inclusive, in the October, 1946, issue; 113-115, inclusive, in the January, 1947, issue; 116-118, inclusive, in the April, 1947, issue; 119-121, inclusive, in the July, 1947, issue; 122-124, inclusive, in the October, 1947, issue; 125-127, inclusive, in the January, 1948, issue; 128-130, inclusive, in the April, 1948, issue; 131-133, inclusive, in the July, 1948, issue; 134-136, inclusive, in the October, 1948, issue.

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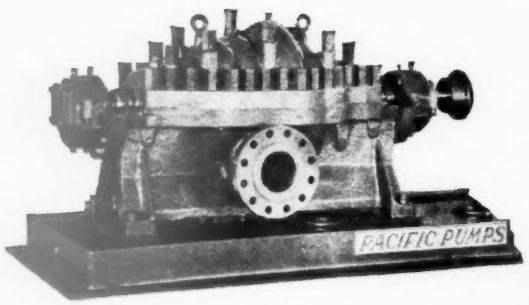
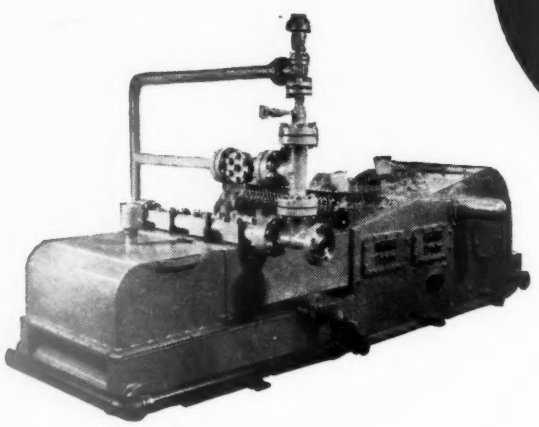


PACIFIC—CENTRIFUGAL PUMP

REPLACES SALESMANSHIP WITH ENGINEERING



CLARK—RECIPROCATING PUMP

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DRILLING CHARACTERISTICS OF DRAG TYPE ROTARY BITS

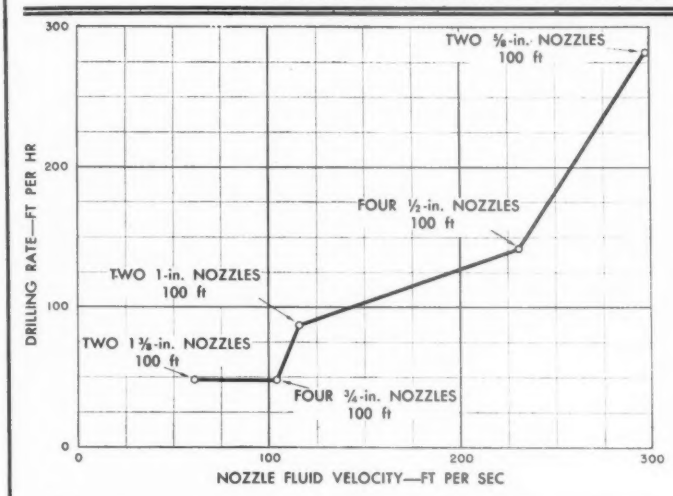

FIG. 10. Left—Variation of drilling rate of two-way drag type bits with nozzle fluid velocity at constant rate of circulation, constant rotary speed, and maximum effective bit weight (rate of circulation 570 gpm; speed of rotation, 140 rpm; bit weight, 2000 to 10,000 lb; data obtained from Frank Schmidt 3 well—5366 to 5866 ft; formation, uniform shale—Texas Gulf Coast.)

FIG. 11. Left below—Calculated relation of hydraulic horsepower with drilling rate at constant speed of rotation and maximum effective bit weight (drill pipe, 4½-in. 16.60 lb EUIF, mud weight 10.0 to 10.3 lb per gal; mud viscosity not determined under conditions of flow).

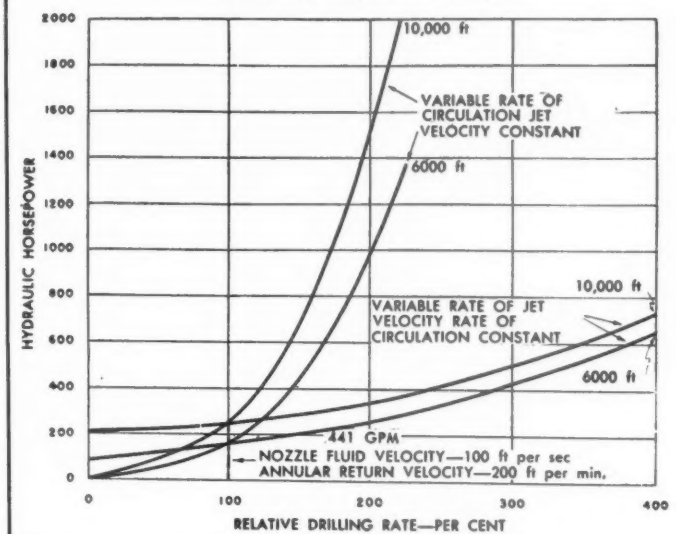
10,000 ft
VARIABLE RATE OF CIRCULATION JET VELOCITY CONSTANT
6000 ft
10,000 ft
VARIABLE RATE OF JET VELOCITY RATE OF CIRCULATION CONSTANT
6000 ft
441 GPM
NOZZLE FLUID VELOCITY—100 ft per sec
ANNULAR RETURN VELOCITY—200 ft per min.
HYDRAULIC HORSEPOWER
RELATIVE DRILLING RATE—PER CENT

FIG. 12. Below—Calculated relation of hydraulic horsepower with drilling at constant speed of rotation and maximum effective bit weight (drill pipe 5-in. OD 19.50 lb equipped with 4½-in. IF tool joints; mud weight 10.0 to 10.3 lb per gal; mud viscosity not determined under conditions of flow).

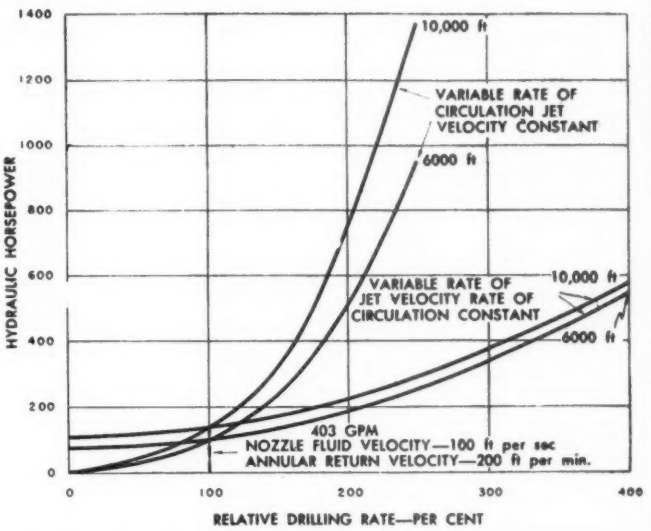
10,000 ft
VARIABLE RATE OF CIRCULATION JET VELOCITY CONSTANT
6000 ft
VARIABLE RATE OF JET VELOCITY RATE OF CIRCULATION CONSTANT
10,000 ft
6000 ft
403 GPM
NOZZLE FLUID VELOCITY—100 ft per sec
ANNULAR RETURN VELOCITY—200 ft per min.
HYDRAULIC HORSEPOWER
RELATIVE DRILLING RATE—PER CENT

TABLE 3. Effect of nozzle fluid velocity and hydraulic horsepower on rate of drilling—*Borregas field, South Texas area*

Lease and well no.	Borregas 19	Borregas 42	Borregas 16
Depth, ft From	2,049	2,064	2,050
To	6,895	6,875	6,872
Hole drilled, ft	4,362	4,429	4,467
Rotating hours	151.78	79.43	39.20
Drilling rate, ft/hr	28.7	59.1	114.0
Average circulating rate, gpm	550	487	700
Number of nozzles and diameter	Two 1 1/8-in. ID	Two 5/8-in. ID	Two 1/2-in. ID
Bit nozzle fluid velocity, ft/sec	90	255	375
Total hydraulic horsepower	200	313	800
Average bit weight, lb	15,000	20,000	30,000
Maximum hole deviation, deg	2½	2½	3¼

TABLE 4. Effect of nozzle fluid velocity and hydraulic horsepower on rate of drilling.

Sugar Valley field, Gulf Coast, Texas

Lease and well no.	A. B. Taylor 2	Truitt and Gravier 2
Depth, ft From	3,050	3,050
To	8,030	8,168
Hole drilled, ft	4,980	5,118
Number of bits used	7	4
Rotating hours	102.30	52.30
Drilling rate, ft/hr	48.68	97.86
Average circulating rate, gpm	736	479
No. and diameter of nozzles	Two 1 1/8-in.	Two ½-in.
Bit nozzle fluid velocity, ft/sec	119	391
Total hydraulic horsepower	403	419
Average bit weight, lb	9,000	25,000
Maximum hole deviation, deg	3¼	4½

In Fig. 10, results indicate that the rate of drilling that can be obtained with drag type bits in the type of shale encountered in the Schmidt 3 is in direct proportion to the nozzle fluid velocity when the rate of circulation is constant and a maximum effective bit weight is maintained.

A comparison of the Borregas wells shows that the drilling rate varied with the nozzle fluid velocity used in the wells. In the Sugar Valley wells, it is seen that a 34 per cent decrease in circulating rate and a 228 per cent increase in nozzle fluid velocity resulted in 101 per cent increase in drilling rate in the Truitt and Gravier 2 when compared with the A. B. Taylor 2, while the hydraulic horsepower developed in the two wells was approximately equal.

In Fig. 11, the variation of relative drilling rate with hydraulic horsepower at (1) variable circulating rate and constant nozzle fluid velocity and (2) variable nozzle fluid velocity and constant circulating rate are shown for 8⅝-in. two-way bits, 4½-in. 16.60-lb EUIF drill pipe and approximately 10.0-lb-per-gal mud at depths of 6000 and 10,000 ft. Fig. 12 shows the same information with the exception that 5-in. OD drill pipe is used in the calculations in place of the 4½-in. EUIF drill pipe.

NOTE: References are shown on last sheet in this series of tables.

Taken from the article, "The Relation of Nozzle Fluid Velocity to Rate of Penetration With Drag Type Rotary Bits," by J. P. Nolley, George E. Cannon, and Douglas Ragland of Humble Oil & Refining Company, which was presented before Southwestern District API Division of Production, San Antonio, Texas, April 14-16, 1948, and published in *The Petroleum Engineer*, June, 1948, pages 86 to 102, inclusive.

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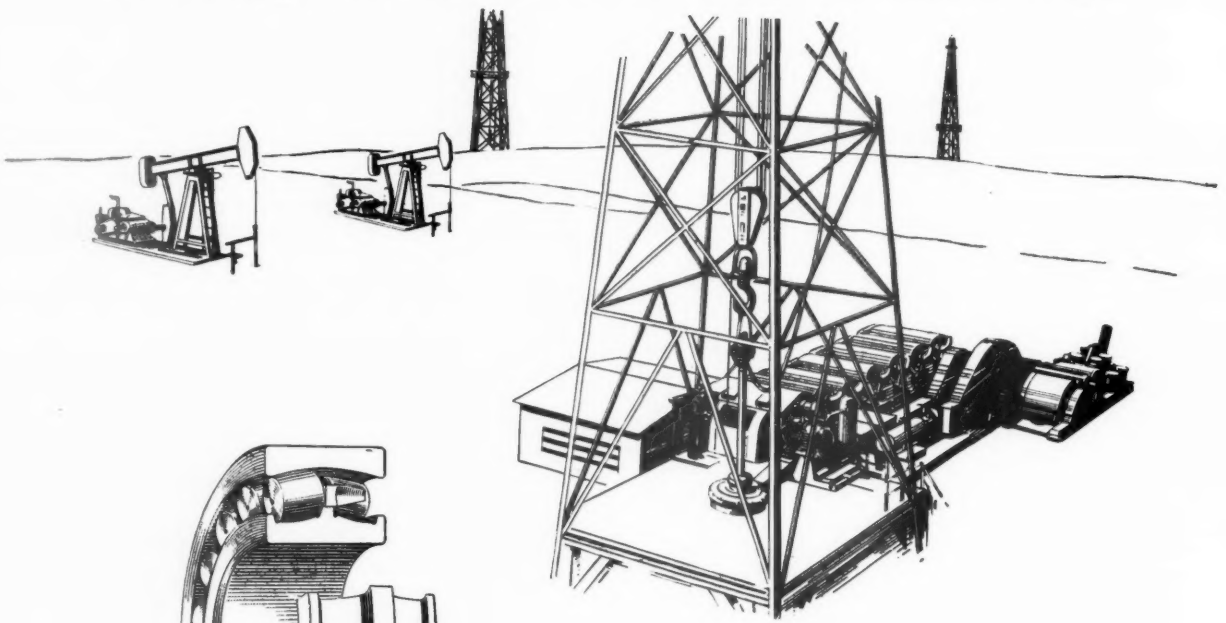

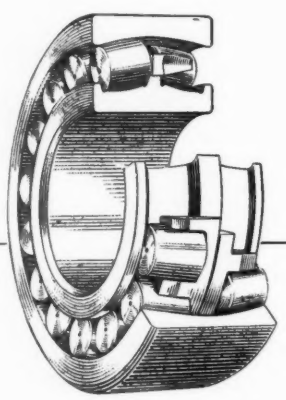

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DRILLING CHARACTERISTICS OF DRAG TYPE ROTARY BITS

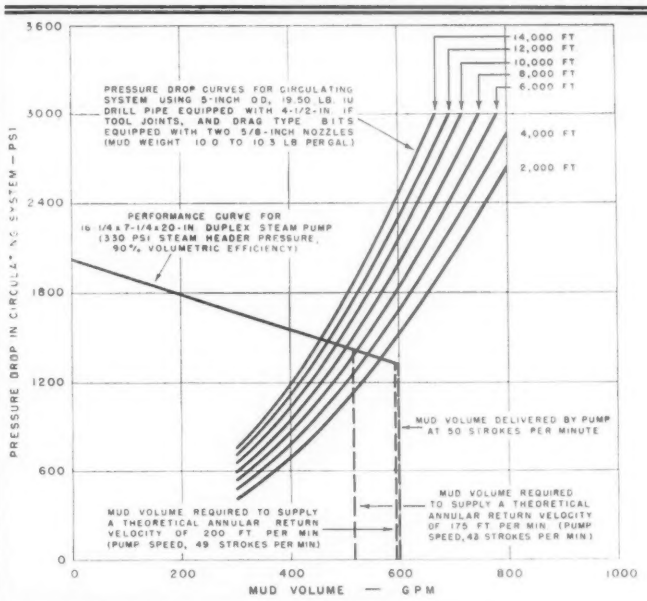
PRESSURE DROP IN CIRCULATING SYSTEM — PSI
MUD VOLUME — GPM
PRESSURE DROP CURVES FOR CIRCULATING SYSTEM USING 5-INCH OD, 19.50 LB. IU DRILL PIPE EQUIPPED WITH 4-1/2-IN. IF TOOL JOINTS, AND DRAG TYPE BITS EQUIPPED WITH TWO 5/8-INCH NOZZLES (MUD WEIGHT 10.0 TO 10.3 LB PER GAL.)
14,000 FT
12,000 FT
10,000 FT
8,000 FT
6,000 FT
4,000 FT
2,000 FT
PERFORMANCE CURVE FOR 16-1/4 x 7-1/4 x 20-IN. DUPLEX STEAM PUMP (330 PSI STEAM HEADER PRESSURE, 90% VOLUMETRIC EFFICIENCY)
MUD VOLUME DELIVERED BY PUMP AT 50 STROKES PER MINUTE
MUD VOLUME REQUIRED TO SUPPLY A THEORETICAL ANNULAR RETURN VELOCITY OF 175 FT. PER MIN. (PUMP SPEED, 43 STROKES PER MIN.)
MUD VOLUME REQUIRED TO SUPPLY A THEORETICAL ANNULAR RETURN VELOCITY OF 200 FT. PER MIN (PUMP SPEED, 49 STROKES PER MIN)

FIG. 19. Method for determining size of nozzles to use in 9⅞-in. two-way drag type bits.

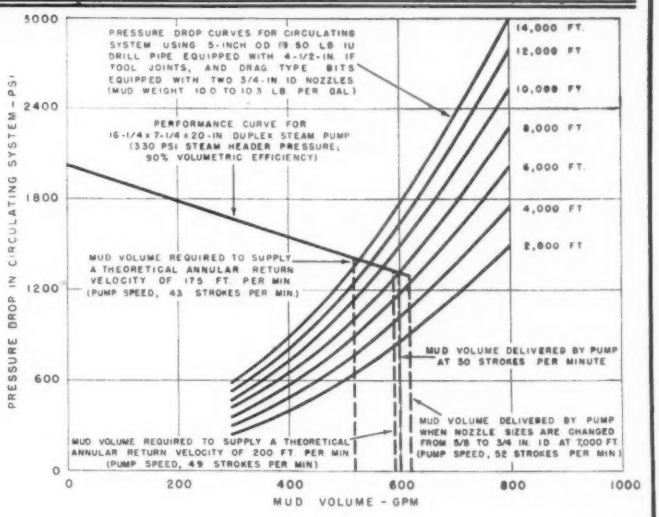
PRESSURE DROP IN CIRCULATING SYSTEM - PSI
MUD VOLUME - GPM
PRESSURE DROP CURVES FOR CIRCULATING SYSTEM USING 5-INCH OD 19.50 LB IU DRILL PIPE EQUIPPED WITH 4-1/2-IN IF TOOL JOINTS, AND DRAG TYPE BITS EQUIPPED WITH TWO 3/4-IN ID NOZZLES (MUD WEIGHT 10.0 TO 10.3 LB PER GAL.)
14,000 FT
12,000 FT
10,000 FT
8,000 FT
6,000 FT
4,000 FT
2,000 FT
PERFORMANCE CURVE FOR 16-1/4 x 7-1/4 x 20-IN DUPLEX STEAM PUMP (330 PSI STEAM HEADER PRESSURE, 90% VOLUMETRIC EFFICIENCY)
MUD VOLUME REQUIRED TO SUPPLY A THEORETICAL ANNULAR RETURN VELOCITY OF 175 FT. PER MIN (PUMP SPEED, 43 STROKES PER MIN.)
MUD VOLUME DELIVERED BY PUMP AT 50 STROKES PER MINUTE
MUD VOLUME DELIVERED BY PUMP WHEN NOZZLE SIZES ARE CHANGED FROM 5/8 TO 3/4 IN. ID AT 7000 FT. (PUMP SPEED, 52 STROKES PER MIN.)
MUD VOLUME REQUIRED TO SUPPLY A THEORETICAL ANNULAR RETURN VELOCITY OF 200 FT. PER MIN (PUMP SPEED, 49 STROKES PER MIN)

FIG. 20. Method for determining size of nozzles to use in 9⅞-in. two-way drag type bits.

The determination of the size of nozzles to use in the 9⅞-in. hole is illustrated in Figs. 19 and 20. In Fig. 19, the performance curve of the 18-in. x 7¼-in. x 20-in. steam pump is plotted in conjunction with the pressure drop in the circulating system of the rig when two ⅝-in. nozzles are in use, and in Fig. 20 the performance curve of the same pump is plotted in conjunction with the pressure drop in the circulating system when two ¾-in. nozzles are in use. The performance curve of the pump was determined by drawing a straight line between the stall pressure of the pump based on a steam header pressure of 330 psi (20 psi lower than boiler pressure to allow for steam line pressure drop) and the operating pressure at 50 spm based on 65 per cent stall pressure and 90 per cent volumetric efficiency. In Fig. 19, it can be seen that the ⅝-in. nozzles can be used to an approximate depth of 7000 ft, at which depth the annular return velocity will have decreased to the minimum recommended rate of 175 fpm. Below 7000 ft, two ¾-in. nozzles should be used since this is the next larger sized nozzle that is used in Humble's drilling program. In Fig. 19, it can be seen that the ¾-in. nozzle could be used satisfactorily to the total depth of the 10,000-ft well and even at depths in excess of 14,000 ft.

Should the size of the rig be such that two 18 in. × 7¼ in. × 20-in. pumps are operated in series, the operating pressure of the two pumps would be twice the amount shown in Fig. 19 and 20. Thus, smaller sized nozzles could be used through the same depth of hole intervals when compared with a single pump operation.

TABLE 5. Effect of nozzle direction and blade curvature on drilling rate.
Truitt and Gravier I, Matagorda County, Texas (Gulf Coast)

Bit no.	Direction nozzles with respect to blades	Blades	Depth From	Depth To	Feet drilled	Drilling time, min.	Circulating rate, gpm	Circulating pressure, psi	Nozzle fluid velocity	Hydraulic horsepower	Drilling rate, ft/hr
1	Tangent and parallel.	Straight	6,175	6,250	75	56.0	608	1700	318	605	80
2	1½-in. in front.....	Straight	6,250	6,325	75	19.9	592	1700	309	588	226
3	⅜-in. in front and parallel.....	Straight	6,325	6,400	75	18.2	592	1700	309	588	247
4	2½-in. in front.....	Straight	6,400	6,475	75	22.1	592	1750	309	605	204
5	⅜-in. in front and parallel.....	Straight	6,475	6,550	75	28.4	592	1750	309	605	158
6	1½-in. in front.....	Straight	6,550	6,625	75	16.6	592	1775	309	613	271
7	Tangent and parallel.	Straight	6,625	6,700	75	14.1	592	1700	309	588	319
8	Standard.....	Curved	6,700	6,775	75	27.7	578	1700	302	574	162

TABLE 6. Effect of nozzle direction and blade curvature on drilling rate.
Average circulating rate—590 gpm. Average nozzle fluid velocity—90 fps
Kleberg County, Southwest Texas area

Well and no.	Bit No.	Bit Type	From	To	Hole drilled, ft	Net rotating time, hr	Drilling rate, ft/hr
Borregas 19.....	1 & 2	Standard 2-Way*.....	2049	4825	2776	45.23	61.37
Borregas 33.....	1	Special 2-Way†.....	2050	4836	2786	40.13	69.42
Borregas 19.....	3	Standard 2-Way.....	4902	5230	328	15.50	21.16
Borregas 33.....	1	Special 2-Way.....	4897	5235	338	5.98	56.52
Borregas 19.....	4 & 5	Standard 2-Way.....	5345	5798	453	20.94	21.63
Borregas 33.....	2	Special 2-Way.....	5323	5788	354‡	15.45	22.91

*Curved blades with nozzles directed to blades.
†Straight blades with nozzles directed 1½-in. in front of blades.
‡Because of two drill pipe washouts, 111 ft of hole and 4.85 hr. were omitted from interval.

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Taken from the article, "The Relation of Nozzle Fluid Velocity to Rate of Penetration With Drag Type Rotary Bits," by J. P. Nolley, George E. Cannon, and Douglas Ragland of Humble Oil & Refining Company, which was presented before Southwestern District API Division of Production, San Antonio, Texas, April 14-16, 1948, and published in *The Petroleum Engineer*, June, 1948, pages 86 to 102, inclusive.

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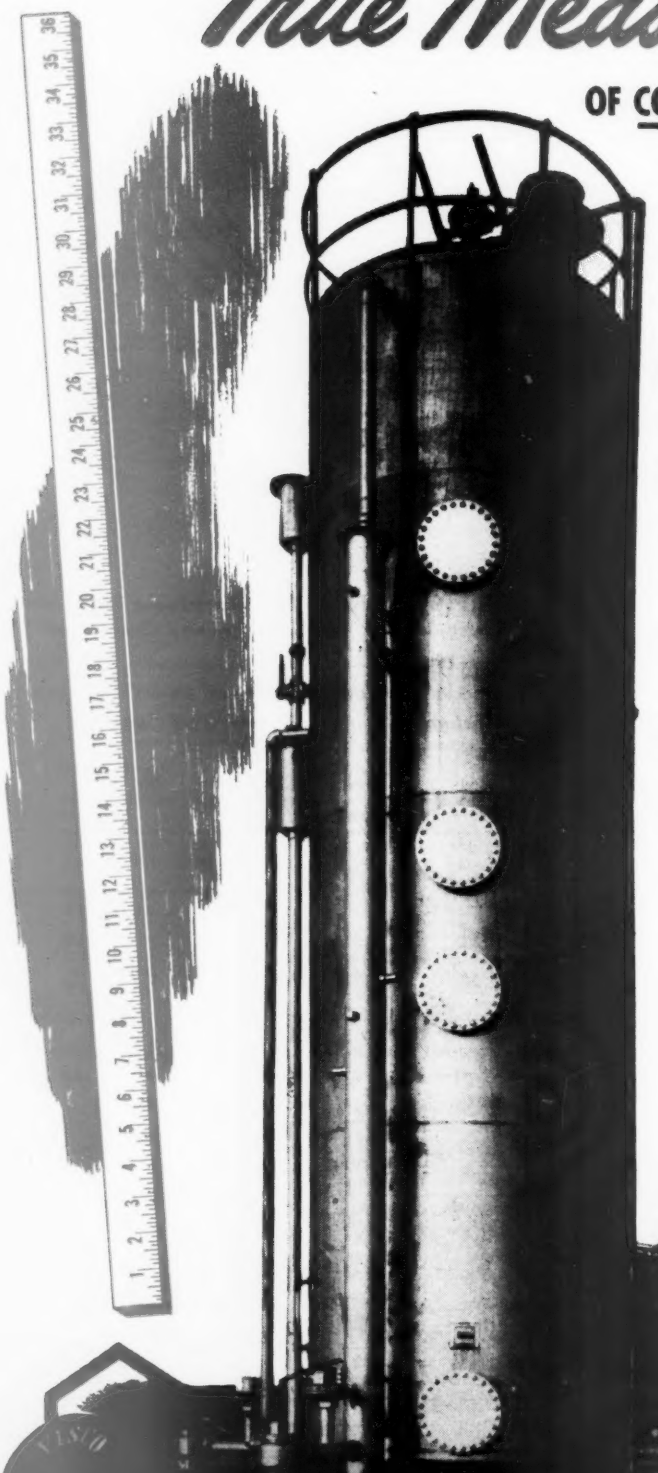

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CHARACTERISTICS OF AUTOMATIC CONTROLS IN GAS OPERATIONS

AUTOMATIC control is playing an ever-increasing part throughout industry. As process problems increase so do those of the control engineer. Many users of automatic controllers have only a hazy notion of how they operate, because the operation of the controllers is an incidental part of their work. Better knowledge of automatic controllers will be of considerable help to them, however, as well as to those responsible for the maintenance of the controllers. The purpose of this paper, therefore, is to present briefly, and in simple terms, the theory of the present-day controller, together with the means by which this theory is translated into practice.

The foregoing discussion has established the action that may be expected from the three types of pneumatic controllers. We should now re-examine these actions to determine just how the pneumatic equipment produces them.

● **On-off control mechanism.** Fig. 8 shows such a controller. The proportioning bellows are disconnected as indicated for on-off action, so that no feedback will occur. For the action shown in the diagram, when the flapper covers the nozzle, pressure is built up above the diaphragm of the control relay. This causes it to move so as to cut off the vent and put the full 17 psi air supply on the control valve. When the flapper leaves the nozzle, air is bled from above the diaphragm of the control relay, which then moves in the opposite direction, cutting off the supply and opening the vent so that pressure on the control valve drops to zero. Opposite control action is obtained simply by moving a lever. Note that aside from the very small amount of throttling inherent in the flapper-nozzle system (less than 1/10 of 1 per cent), only two positions of the control valve are possible. It is either open or shut.

Although the on-off controller is not used to any extent in the natural gas industry, special adaptations of on-off action are of considerable interest. One such case is the differential limit controller, which is used for automatically cutting in a second meter run when the capacity of the first is reached.

A common illustration of this type of control is the thermostat in an ordinary home, which measures the temperature in the room and, if the measurement is low, turns on the furnace and keeps it running until the measurement has reached the control point, at which time the furnace is shut off again. When the measurement again drops below the control point, the furnace is turned on, and so the cycle continues.

It follows, therefore, that the measurement of an on-off controller must be continually cycling when it is in operation; otherwise, the valve would remain at either the open or the closed position.

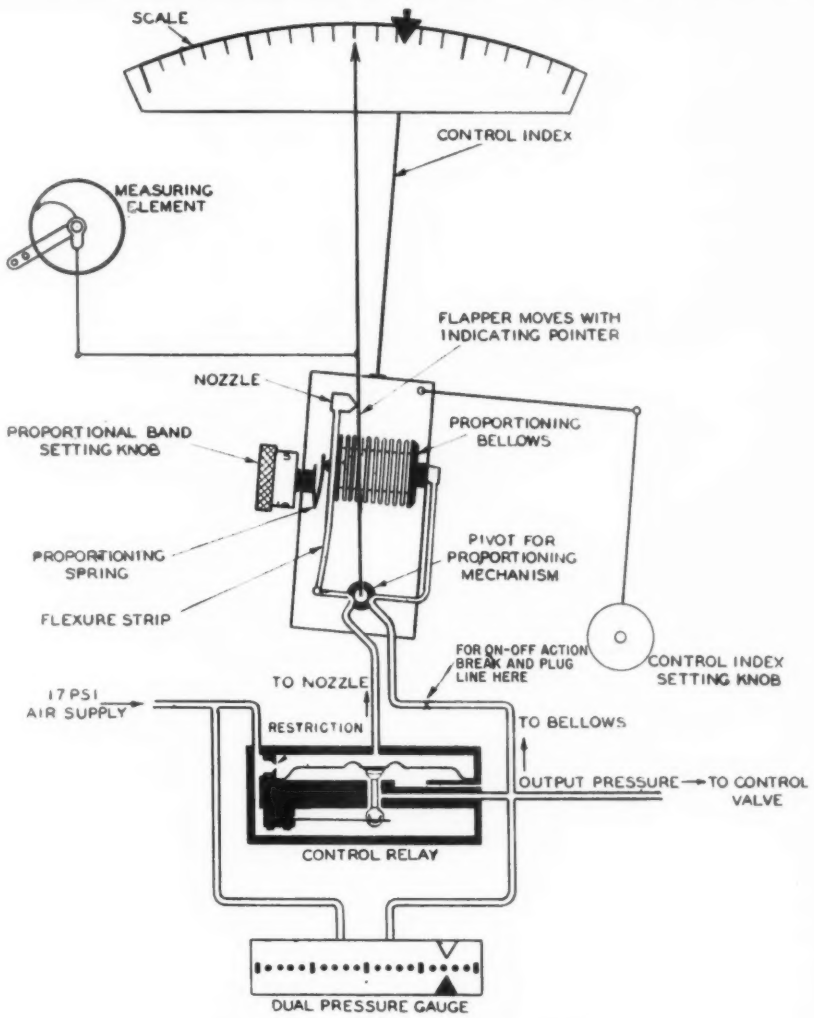

FIG. 8. "On-off" control valve mechanism.

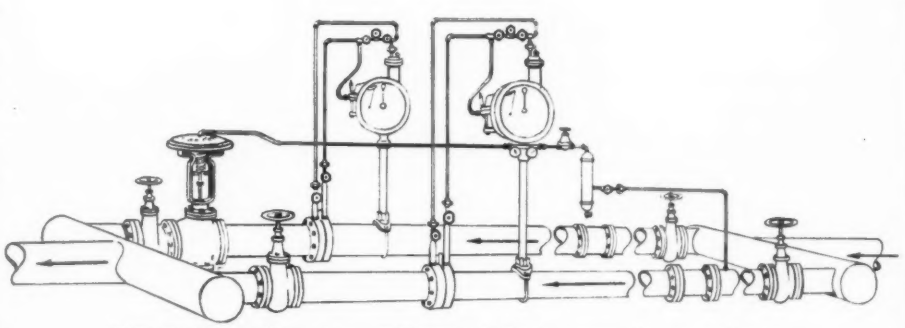

FIG. 9. Recording type differential limit controller installation.

Fig. 9 is a sketch showing a differential limit controller installation of the recording type in which the limit mechanism is added to a standard flow recorder. The on-off control valve in the secondary line is positioned by the differential limit control mechanism, which is operated by the primary line differential.

Taken from the article, "Automatic Controls in Gas Operations," by L. W. Parten, The Foxboro Company, which was presented before the second annual Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Texas, May 27-30, 1947, and published in *The Petroleum Engineer*, Reference Annual, 1948, pages 189 to 200, inclusive.

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CHARACTERISTICS OF AUTOMATIC CONTROLS IN GAS OPERATIONS

The mechanism for this type of controller is shown in Fig. 10. The nozzle positions are set by the high and low indexes at the differentials at which it is desired to have the secondary meter run cut in and out. For a 100 in. range meter, this could be at 98 in. and 10 in. These settings are easily changed, however, by external setting knobs. The index pointer, or pen arm for the recording type, is actuated by the meter bearing shaft and carries the striker arm that lifts the flappers from their corresponding nozzle when the pointer is below the corresponding index setting. The striker arm permits the flappers to cover these nozzles when the pointer is above the corresponding index setting.

Let us assume that the controller is in service. The differential pointer, or pen, is at zero and below the low index setting, so both high and low nozzles are uncovered. The spring of the lock-up unit has pulled the flapper from its nozzle, and there is no pressure in the diaphragm of the control relay, so its stem is thrown to the left, shutting off the vent and putting full supply pressure on the control valve, which is thus closed. As the differential rises, the low nozzle is covered by its flapper, but nothing happens, for the high nozzle and the lock-up unit nozzle are still uncovered. The differential may range, therefore, from zero to just below the high index with only the primary line in service. As soon as the high index point is reached, however, the high nozzle is covered, which puts pressure in the pusher (1) hydron, moving the lock-up units flapper to the right and covering its nozzle, so that pressure also builds up in the pusher (2) hydron and in the diaphragm of the control relay, which throws to the right, venting the line to the control valve, which thus opens and cuts in the secondary meter. As the flow is now split, the flow through the primary line decreases, uncovering the high nozzle, but nothing happens, for pressure in pusher (2) hydron holds pressure in the rest of the pneumatic system. It is thus seen that if the pointer is positioned anywhere between the two indexes, the measuring system will operate either with the primary line alone or with both lines in service. The determining factor is which index setting was reached last. Reverse action is obtained by changing the control relay to the opposite type. At constant line pressure, a double meter run as described, will handle a flow range of 12 to 1. Wide range meters on both primary and secondary lines will take care of a flow range of 35 to 1. A third meter run will increase the range to 180 to 1. If the line pressure drops with increasing flow, the above ranges are decreased by the ratio of the square roots of the absolute pressures. If the line pressure is higher during the higher flow, the ranges are increased correspondingly.

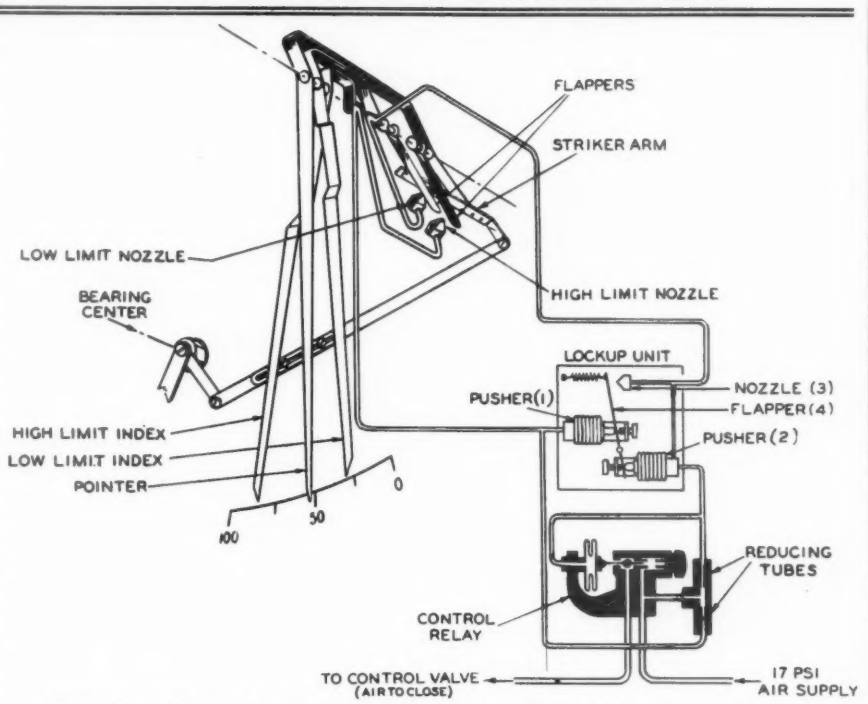


FIG. 10. Differential limit control mechanism for "on-off" control valve.

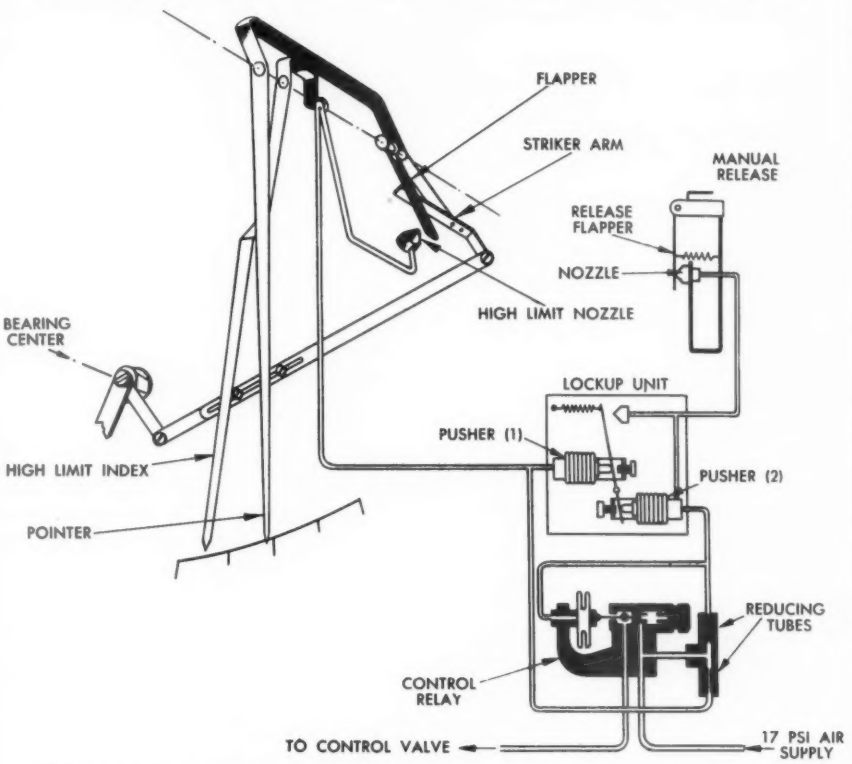
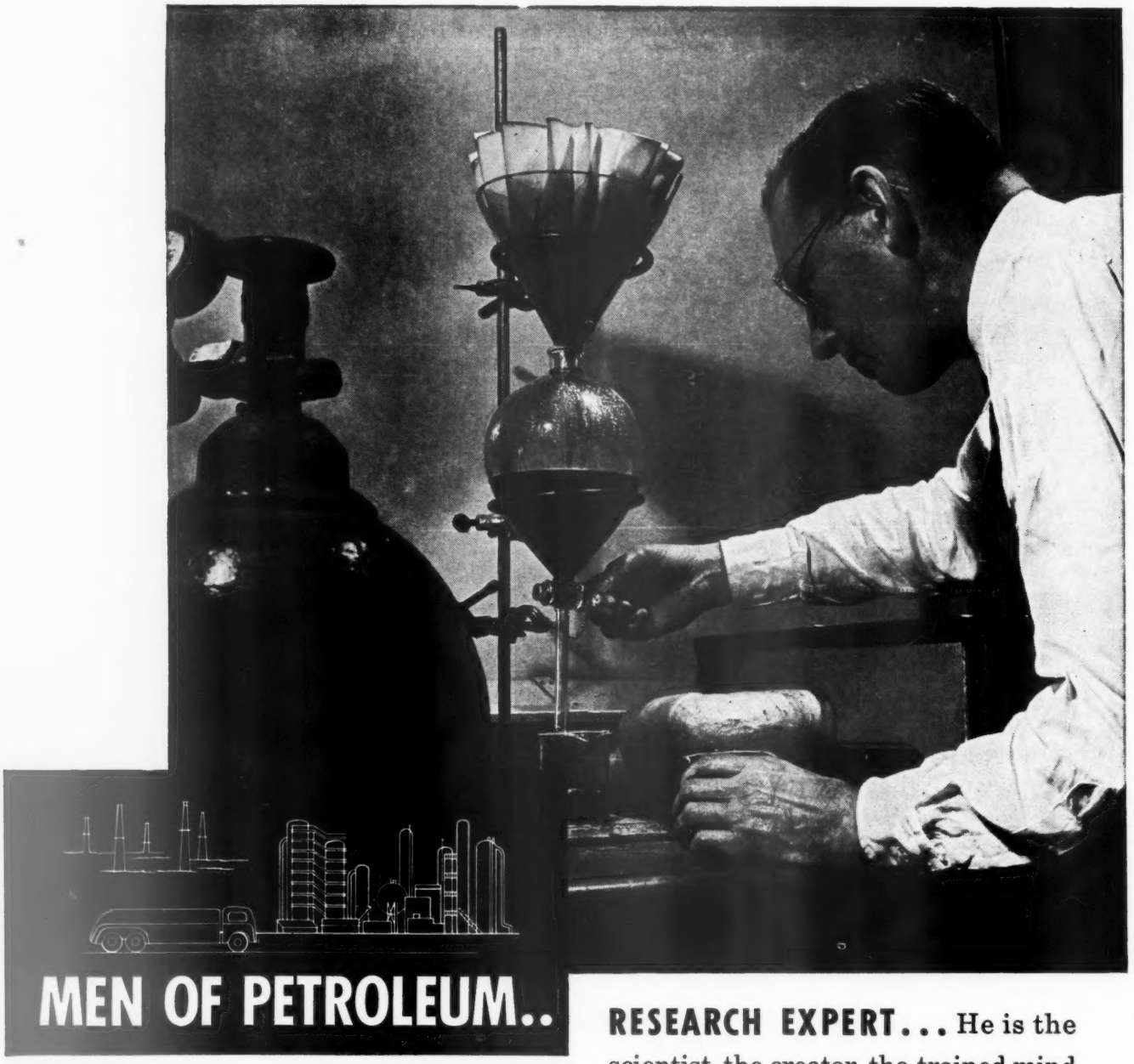


FIG. 11. Control mechanism for "on-off" control valve with manual release.

The use of the pilot type lock-up mechanism permits consistent repeatability of cut-on and cut-off points. One might say that this control holds the control point. This characteristic is most important at the low setting, because an erratic cut-off at this point would result in a substantial loss of range, and a wide range is the characteristic that differential limit controllers are installed to obtain.

Taken from the article, "Automatic Controls in Gas Operations," by L. W. Parten, The Foxboro Company, which was presented before the second annual Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Texas, May 27-30, 1947, and published in *The Petroleum Engineer*, Reference Annual, 1948, pages 189 to 200, inclusive.



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CHARACTERISTICS OF AUTOMATIC CONTROLS IN GAS OPERATIONS

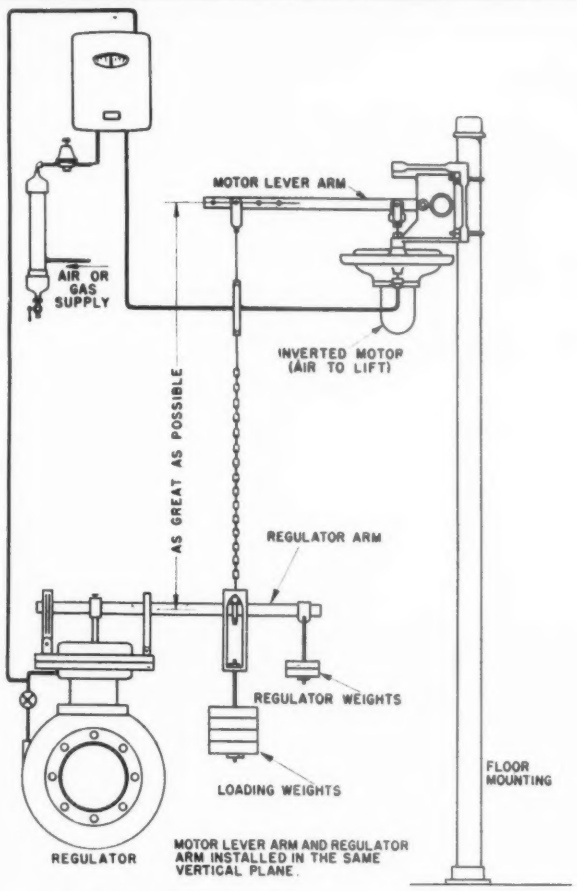

FIG. 12. Proportional pressure controller with adjustable index setting and weighted regulator.

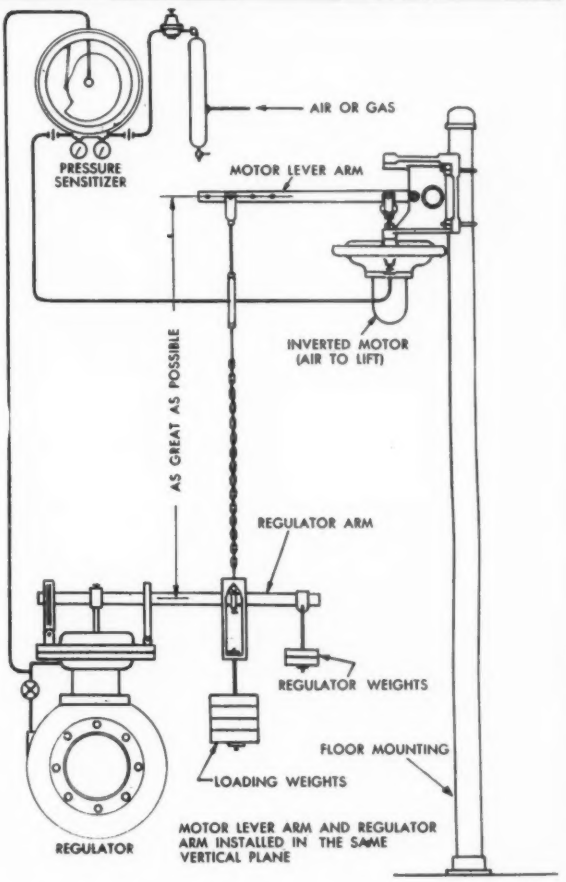

FIG. 13. Proportional pressure controller with time-cam type pressure sensitizer and weighted regulator.

Fig. 12 shows how the pressure sensitizer changes weights automatically. The instrument, a proportional type controller, operates through a diaphragm motor lever to increase or decrease the loading of the regulator. This motor lever arm is attached through a chain and turnbuckle to a slotted yoke, which carries sufficient additional loading weights to hold maximum pressure at maximum demand.

The time-cam type of pressure sensitizer is very similar except that the output pressure is changed in accordance with a predetermined schedule, which is cut out on an aluminum cam that is rotated by a clock, so as to hold a given pressure at a given time. Fig. 13 shows this type of control, which is sometimes used at town-border pressure-reducing stations for packing transmission lines in advance of loads. Seasonal variations of the schedule are made by changing cams.

A controller with action that returns the controlled variable to the control point is shown in Fig. 14. The nozzle assembly is fixed as concerns vertical or lateral motion, but it may be rotated to change the width of the proportional band and to obtain the opposite control action.

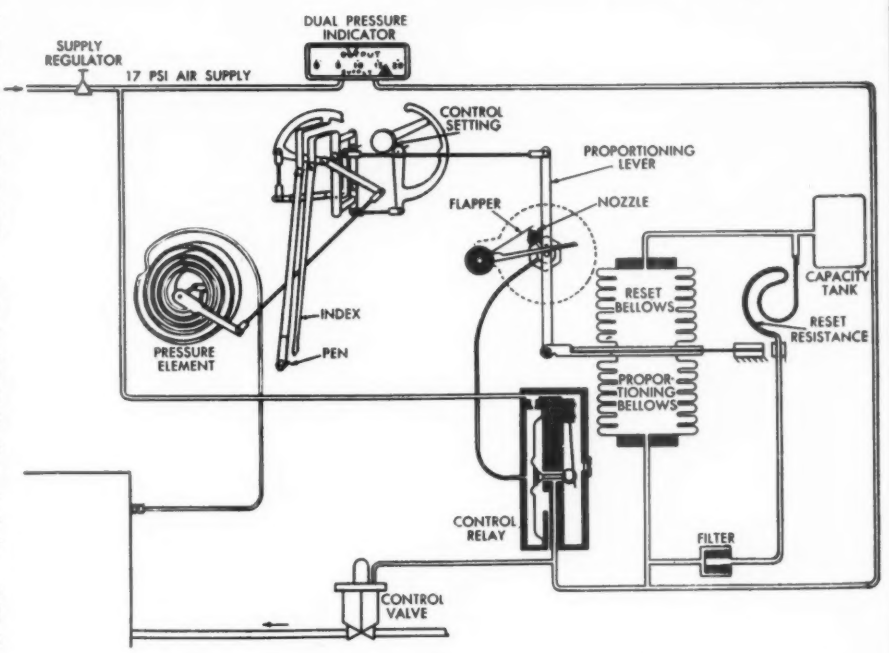

FIG. 14. Schematic diagram of "Proportional with Reset" Controller.

Taken from the article, "Automatic Controls in Gas Operations," by L. W. Parten, The Foxboro Company, which was presented before the second annual Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Texas, May 27-30, 1947, and published in *The Petroleum Engineer*, Reference Annual, 1948, pages 189 to 200, inclusive.

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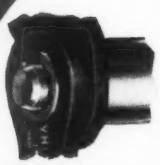

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CHARACTERISTICS OF AUTOMATIC CONTROLS IN GAS OPERATIONS

Fig. 15 shows flow curves of several types of valves plotted on semi-log paper. The ordinates reading "per cent of total lift" might also have a scale reading "pressure on diaphragm of control valve." The heaviest line has what is known as equal percentage characteristics. By that we mean that equal changes in pressure on the diaphragm of the valve increase or decrease the flow by equal percentages of the existing flow regardless of the valve position at the time of the change. For example, at 10 per cent lift, the flow through the valve is 2.75 per cent of maximum. At 20 per cent of lift, the flow becomes 4.1 per cent of maximum, or an increase of 50 per cent over the previous flow. Farther up the scale, for example, at 40 per cent lift, the flow through the valve is 9.2 per cent of maximum. With the same increase in pressure, that is, to 50 per cent lift, the flow becomes 13.8 per cent of maximum. This is likewise a 50 per cent increase over the previus value. At a third point on the scale, namely, 80 per cent of lift, the flow through the valve is 45 per cent of maximum, and at 90 per cent of lift (again the same increase in pressure on the valve), the flow becomes 67.5 per cent of maximum, or a 50 per cent increase over the previous flow.

The practical value of this percentage characteristic may be brought out by examples. Let us assume that a control valve in the steam line of a reboiler at a natural gasoline plant keeps the process balanced with 10 psi pressure on the diaphragm of the valve and a certain pressure drop across the valve. A given process disturbance requires a 10 per cent change in steam flow to keep the process balanced, or the steam supply pressure may be lower at another time, so the valve, in order to pass the same amount of steam, must be open wider as the pressure drops.

Fig. 16 shows how valve lift may be plotted against rate of flow. Valve sizing is of rather minor importance with equal percentage valves of wide range. For example, if a 2-in. valve is operating at 78 per cent lift (A), a 3-in. valve on the same application would operate at 58 per cent lift (D) to pass the same flow. Now if a change in load occurs that would cause the 2-in. valve to drop to 64 per cent lift (C), this change would, of course, affect the 3-in. valve in a like manner. To decrease the flow the same percentage, the 3-in. valve would change to 44 per cent lift (F), an equal percentage decrease. In other words, triangles A B C and D E F are similar and equal. Hence, no change in controller adjustments would have to be made, if one valve were substituted for the other. Although operators should not be encouraged to install oversize control valves, it is interesting to note that the wide range, equal percentage valve just described will handle such control problems effectively.

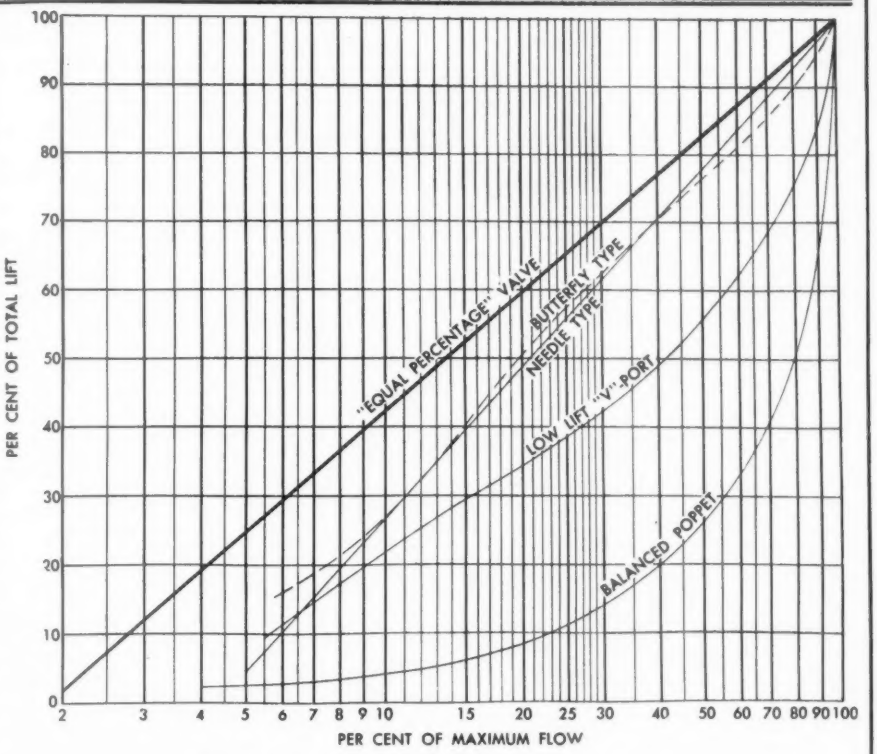

FIG. 15. Flow curves of several types of valves.

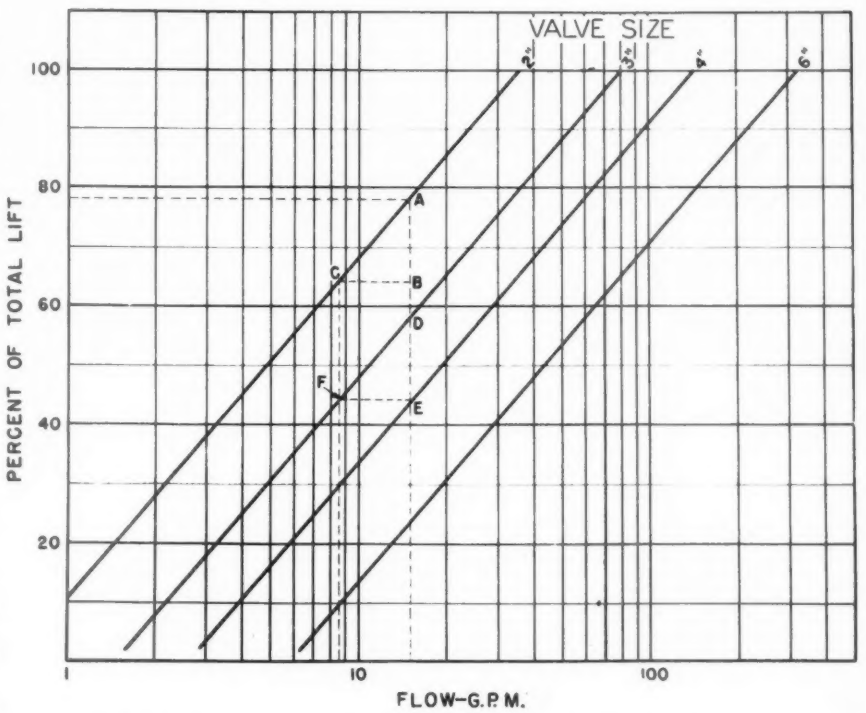

FIG. 16. Flow curves of several sizes of "equal percentage" valves.

Correct sizing of equal percentage valves is not critical, provided that the size is ample for maximum demand and that the range may be increased without the necessity of changing the controller settings.

Taken from the article, "Automatic Controls in Gas Operations," by L. W. Parten, The Foxboro Company, which was presented before the second annual Gas Technology Short Course, Texas College of Arts and Industries, Kingsville, Texas, May 27-30, 1947, and published in *The Petroleum Engineer*, Reference Annual, 1948, pages 189 to 200, inclusive.

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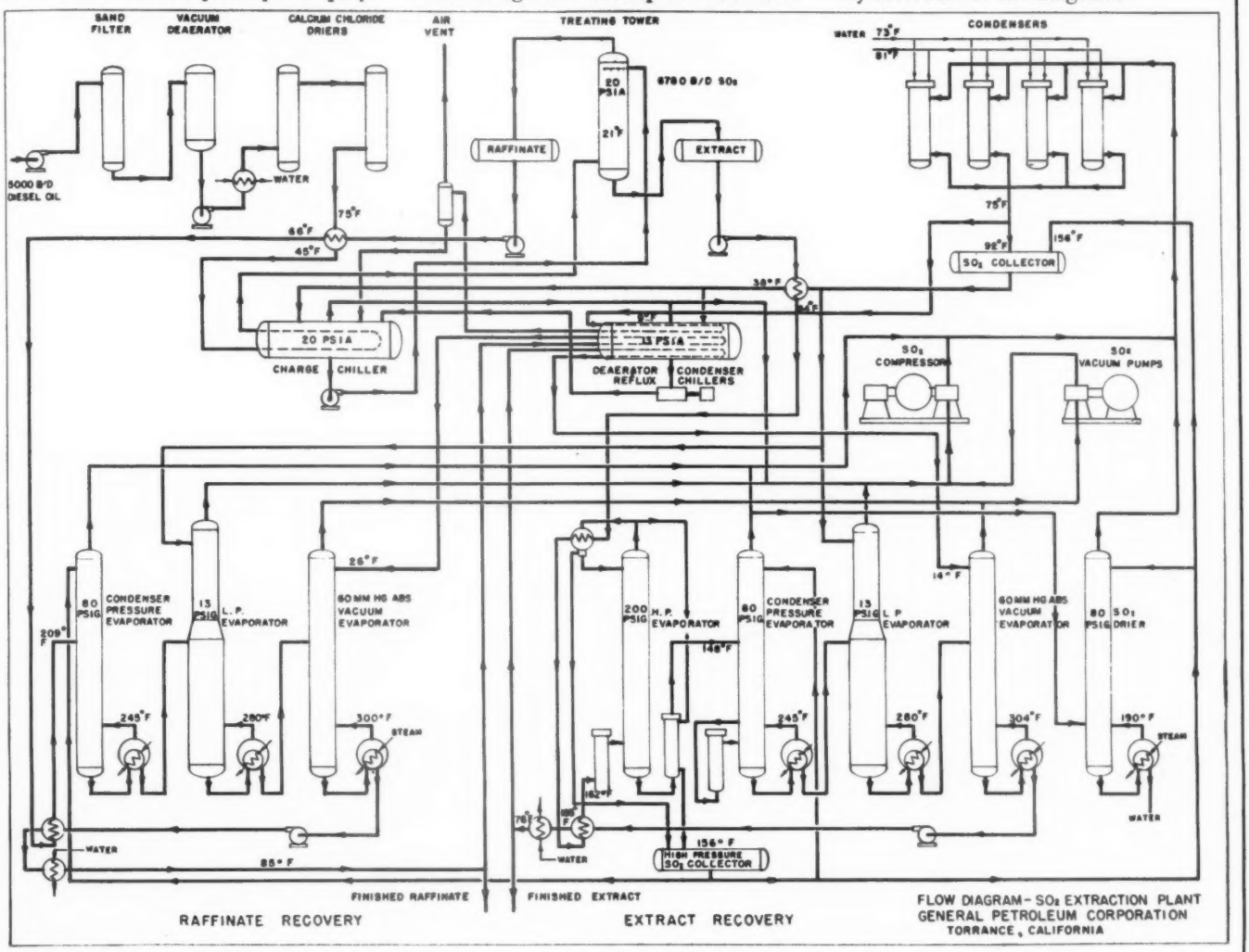
SO_2 EXTRACTION UNIT: FLOW AND OPERATION

The Edeleanu process is based on the selective solvent principle employing liquid sulphur dioxide as the extraction agent. A description of the flow through the unit can be accomplished by reference to the diagram.



Drawing shows conditions of temperature and pressure at control points when producing 50 cetane automotive diesel.

TABLE 1. Operating data.

	50 cetane diesel oil	Kerosine
Charge rate, bbl/day	5000	4550
SO_2 rate, bbl/day	6750	7300
SO_2 contact ratio, per cent	135	160
Temperatures, F		
Treating tower	21	8
Charge chiller (shell)	27	14
Deaerator condenser (shell)	9	10
Main SO_2 collector	92	95
High pressure SO_2 collector	156	156
Extract evaporators		
Condenser pressure reboiler	245	234
Low pressure reboiler	280	280
Vacuum reboiler	304	306
Raffinate evaporators		
Condenser pressure reboiler	245	235
Low pressure reboiler	280	280
Vacuum reboiler	300	304
Pressures		
Charge chiller, psia	20	15
Deaerator condenser, psia	13	13
Treating tower top, psia	20	15
Extract high pressure evaporator, psig	200	200
Condenser pressure line, psig	80	80
Low pressure line, psia	13	13
Vacuum evaporator line, mm Hg abs	60	190

TABLE 2. Yields and properties.

Kerosine

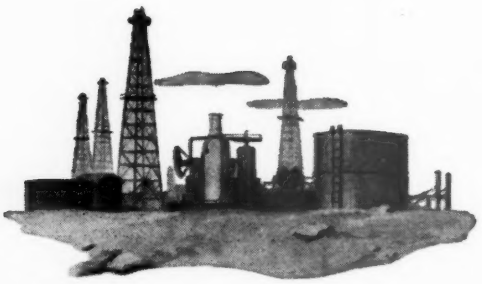
	Charge	Extract	Raffinate	Acid treated raffinate
Volume per cent based on charge	100.0	23.5	76.5	
Color, Saybolt	14		30+	30+
Color stability, Saybolt			30+	30+
Color, Union		1½		
Flash point, F	140	144	134	
Thermal viscosity	355	335	385	385
Sulphur	0.19	1.02	0.05	0.03
Conradson carbon in 10 per cent bottoms	0.02	0.05	0.006	0.001
Aromatics and unsaturates, per cent	18	75.0	2.0	1.0
Aniline point, F	128.8	16.9*	156.0	156.4
Smoke point	18		27	27
72-hr burning test			Failed	Good
Gravity, API	38.4	26.8	42.5	42.4
Distillation				
In	347	345	340	340
5 per cent	370	367	365	366
10 per cent	376	376	376	377
20 per cent	389	391	390	391
30 per cent	401	403	400	403
40 per cent	412	414	411	413
50 per cent	422	425	422	423
60 per cent	432	435	431	432
70 per cent	441	445	441	441
80 per cent	454	458	453	453
90 per cent	467	473	468	468
End point	500	509	499	500
Recovery	99	99	99	99

*Calculated.

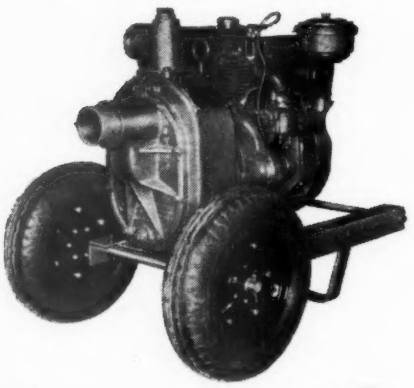
50 cetane diesel oil

	Charge	Extract	Raffinate
Volume per cent based on charge	100.0	25.0	75.0
Cetane number	40.0		50.0
Color—Union	3	6	1
Flash point, F	180	180	180
Viscosity—SU/100	35	35	35
Water and sediment	0.0		0.0
Pour, F	−30		−15
Sulphur, per cent	0.34	1.25	0.09
Conradson carbon in 10 per cent bottoms	0.04	0.22	0.02
Aromatics and unsaturates	24	78	3
Aniline point, F	139.6	13.9*	169.5
Gravity, API	32.8	20.7	38.2
Distillation			
Initial	390	396	394
5 per cent	434	434	436
10 per cent	446	444	446
20 per cent	458	457	458
30 per cent	467	467	469
40 per cent	477	478	480
50 per cent	489	491	493
60 per cent	503	504	507
70 per cent	519	519	523
80 per cent	539	538	542
90 per cent	566	564	567
End point	616	628	614
Recovery	99	99	99

Taken from the article "SO_2 Extraction Unit Complete at Torrance," by S. W. Dickey, published in *The Petroleum Engineer*, August, 1948, pages 76 to 88, inclusive.



MARLOW Self-Priming Centrifugal Pumps for the Oil Industry



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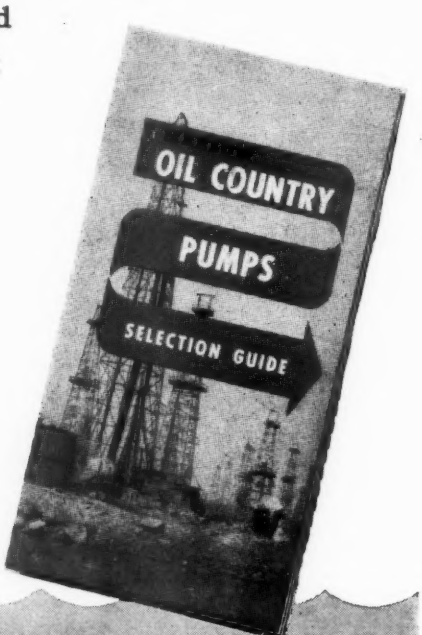

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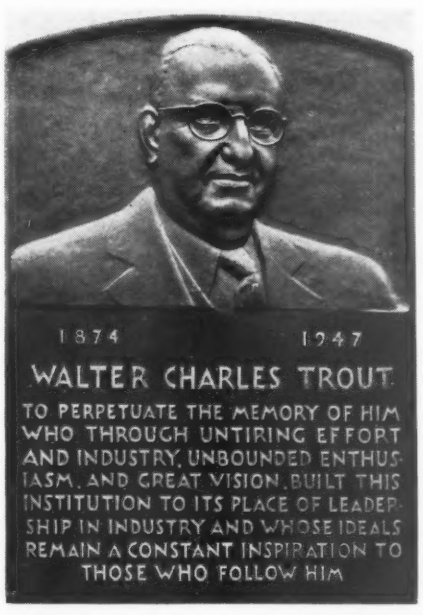
NEWS

Holds Enviable Record

Guest of honor at a dinner given in Colorado Springs by Continental Oil Company officers and executives was Elmer Hanlin, Denver tank truck driver, who was presented a gold watch by President L. F. McCollum in recognition of an unbroken record of 42 years of service without accident and without loss of time due to illness.

Hanlin, who started work for Continental in Denver in January, 1906, driving two horses and a 600-gal 2-compartment tank wagon, has driven an automotive unit on the streets of Denver for the past 28 years with a perfect safety record. He is still on the job, but expects to retire in February, 1949, to spend part of his time with his three children, two grandchildren and one great grandchild, and part of his time fishing.

The dinner closed a 10-day business conference attended by approximately 136 Continental officers and executives from throughout the United States.


1874 1947
WALTER CHARLES TROUT
TO PERPETUATE THE MEMORY OF HIM WHO THROUGH UNTIRING EFFORT AND INDUSTRY, UNBOUNDED ENTHUSIASM, AND GREAT VISION, BUILT THIS INSTITUTION TO ITS PLACE OF LEADERSHIP IN INDUSTRY AND WHOSE IDEALS REMAIN A CONSTANT INSPIRATION TO THOSE WHO FOLLOW HIM

***A memorial plaque** to the late Walter Charles Trout was unveiled November 24 at Lufkin, Texas. The plaque was dedicated by the employes of Lufkin Foundry and Machine Company of which he was president. A. E. Cudlipp made the dedicatory remarks at the ceremony.*

Trout became associated with the company in 1905 when he was 31 and was a guiding force in the spectacular growth of the firm from a repair shop to a factory serving world markets.

Golden Bird Safety Incentive

A bright golden owl with flashing green goggles was presented at the National Safety Congress in Chicago. The bird is worn by members of the Wise Owl Club.

The club is a peace-time version of the famous Caterpillar Club of the United States and British air forces. Only fliers who had saved their lives by jumping from a plane and coming down by parachute could become members of the Caterpillar Club. The Wise Owl Club admits only men and women who have been saved from blindness in an accident because they were wearing safety goggles.

Joseph Folks, a skilled grinder employed for 17 years in the St. Louis plant of American Car and Foundry Company, had such an accident and suggested the club. ACF recognized that here was a great psychological idea—an "incentive tool"—to make men want to wear safety goggles.

So far the club has enrolled just over 150 members. The rules are strict. There must be incontrovertible evidence of an accident that would have caused blindness. At an official ceremony the plant manager presents the wise owl badge, and calls on the new member to be a missionary for eye safety.

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Petroleum Profile

A. C. RUBEL
Union Oil
Company
of California

IT would be difficult, indeed, to find anyone more adequately equipped physically, mentally—and temperamentally, for the rigorous life of a drilling and production executive, than Albert Chatfield Rubel, vice president of Union Oil Company of California. Perennially youthful, keenly analytical, aggressive, and possessed of a boundless energy, Cy, as he is widely and popularly known, has that innate curiosity for which the Missourians are famed. He takes nothing for granted, but must see — and usually try — for himself, anything that appears likely to influence current field practice.

A geologist invents a bathysphere for taking gravitometer readings from the ocean bed, so Cy Rubel makes a personal descent to see if the fellow really has something. A drilling superintendent is going to try out a special kind of bit on the Jimson well at 2 a.m., so at 2 a.m., Cy Rubel is out on the derrick floor, looking as if he had always been there. The company decides to go into a joint venture with the Paraguayan government, so he dashes to South America.

He has been doing this sort of thing, without surcease, for the past 30 years, more or less. Many a less robust individual would wilt under the strain, but not A. C. Rubel—he thrives on it!

A. C. Rubel was born in Louisville, Kentucky, in 1895, but received his early education in Indianapolis, Indiana. He later attended Purdue University, and was graduated in mining engineering from the University of Arizona in 1917. Following his graduation, he spent two years in the first World War, and became known as Captain Rubel of the 304th Engineers. When pressed real hard, he will admit that he was awarded the Croix de Guerre and received the Distinguished Service Cross, but he is far from loquacious about these matters.

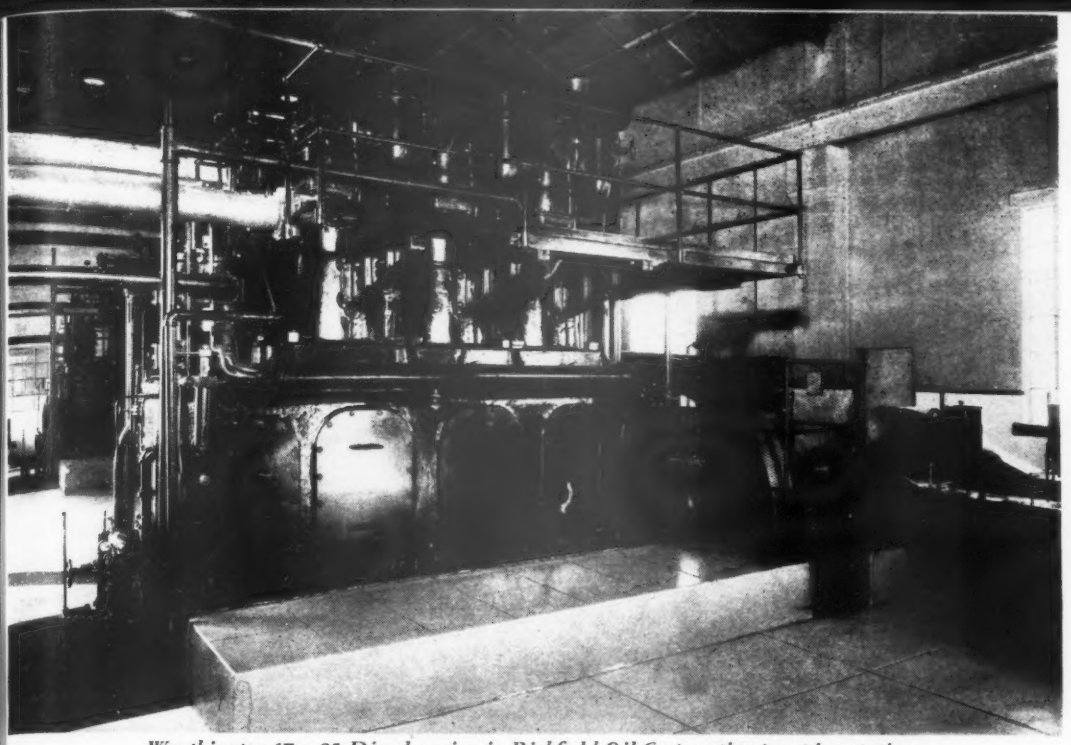
On his return from France, he spent several years in Mexico and Guatemala, making geological surveys for a number of companies. At the conclusion of this adventure, he came back to the United States, and soon thereafter married Henrietta Rockfellow, daughter of the late John A. Rockfellow, pioneer Arizona mining engineer and author.

In 1922 A. C. Rubel was employed by Union Oil Company of California as geologist, assigned to subsurface and general exploratory work. Six years later he was appointed field superintendent of the Dominguez District in the Los Angeles Basin. In 1929 he became chief petroleum engineer, with jurisdiction over all fields. By 1932, he was manager of operations, and in 1936, he was given the additional responsibility of directing the acquisition of lands and the conduct of exploratory work in all territories. In 1939, he was elevated to his present position—vice president.

Since that time, and largely under the Rubel impetus, Union Oil Company of California has greatly expanded its exploratory effort, and is now active in such farflung domestic areas as Louisiana, Texas, Colorado, and Washington, and has extensive foreign interests in Paraguay and Canada. It should also be mentioned in passing that A. C. Rubel was extremely active in the early development of gas-lift in California; had the daring, during the over-production period, to pump back into fee owned properties oil purchased from lessors and others under contract; and has in the past few years been a leader in the study of secondary recovery.

In addition to his immediate company affiliation, he is a vigorous member of the American Petroleum Institute and has occupied important posts in the drilling and production sections during the past 20 years.

It is only a short time since he gave up such strenuous pursuits as handball and squash, and he now finds sufficient diversion in such elevated interests as his family—Mary Ann and Jack; the history of Arizona, Latin-American art and culture, and let us not forget the musical saw. Among Union Oilers Cy Rubel is a popular executive. It is commonly said of him that "he will fight for his boys," and when an employe says that of his boss, it means just one thing — the boss rates. * * *



Worthington 17 x 25 Diesel engine in Richfield Oil Corporation pumping station

How Much Wear Should an Engine Suffer in 23 Years?

In 1924, ten Worthington 17 x 25 3-cylinder air injection Diesel engines were installed on the Richfield Oil Corporation's pipe line from Taft to Wilmington, Calif., to drive pumping equipment.

This 10-inch pipe line extends 127 miles, crossing coastal mountain ranges, and carries crude oil varying from 22 to 32 deg., API, at a rate of 27,000 to 33,000 barrels per day and a discharge pressure of 550 to 700 psi. There are five pumping stations, in each of which are two pumping units. The engines are rated 300 hp at 200 rpm.

The engines were put into operation early in 1925 and have been in virtually continuous service since then. Shutdowns over the 23-year period have been only for routine maintenance.

In 1948, a reconditioning program was begun, involving dismantling to a point permitting inspection of all wearing parts. Of the engines thus far overhauled, the maximum cylinder liner wear encountered was found to be .050 in. The Richfield company considered that with so little wear it would not be necessary to replace the liners or pistons.

Main bearings and Conrod bearings (with the exception of a single Conrod bearing) were found to be in excellent shape and were merely cleaned up and returned to service.

This performance is considered to be extremely good in view of the somewhat unfavorable conditions of cooling water and temperature. At most of the stations there is a scaling problem and it is necessary periodically to remove scale from jackets. Temperature of the water ranges from 80° F in winter to 100° F in summer.

Chemicals From Natural Gas

One of the first plants in the Texas territory to produce chemicals from hydrocarbons obtained from natural gas is Celanese Corporation of America's "Chemcel" Plant at Bishop, Texas.

The photograph shows a view of ten Worthington LTC-8 Angle Compressors, representing a total of 10,000 hp, processing formaldehyde, acetaldehyde, and acetic acid.

These ten compressors are only a portion of the thousands of dollars worth of Worthington equipment in use at the Celanese Corporation's Bishop plant. Among the other Worthington units are four-cycle gas engines, driving water circulating pumps, and between four and five hundred Worthington pumps of various sizes and types. Many of the pumps are "Worthite" Chemical Pumps.

Worthington Angle Compressors at Celanese Corporation's plant in Bishop, Texas

NEWS

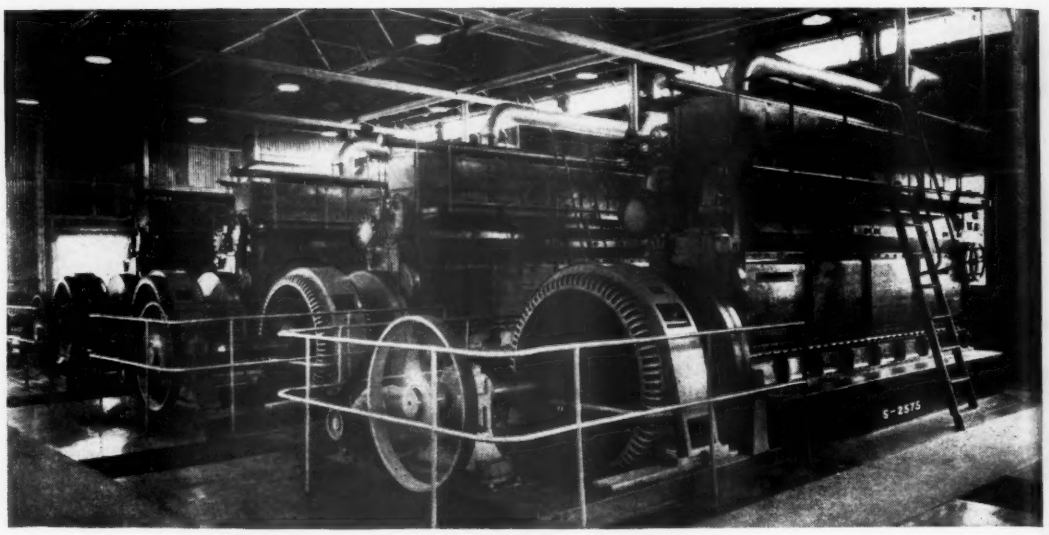
FROM THE PETROLEUM FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

NEWS

from the petroleum front



Worthington natural gas engines for electric power generation.

Much Going on in Notrees, Texas

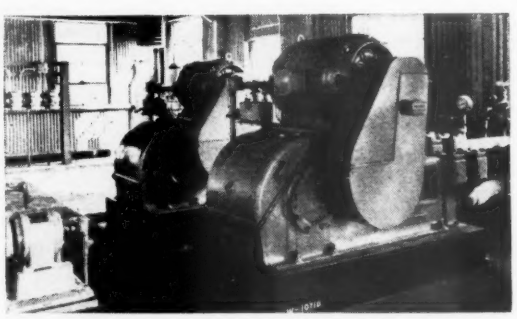
Shell Oil Company's TXL plant at Notrees, Texas, is processing 50,000,000 cu ft of raw gas per day for the purpose of recovering butane, propane and gasoline. There is a large quantity of dry natural gas left as a by-product and this is sold to a natural gas pipe line company for distribution and sale domestically and industrially.

Worthington pumps and gas engines take part in this enormous operation by—

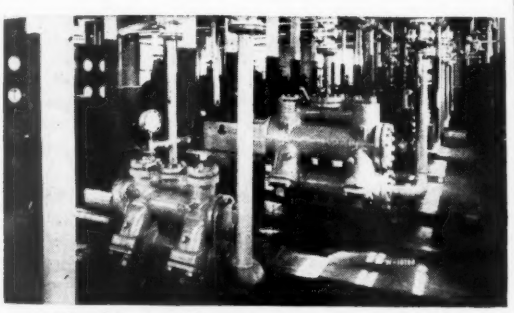
1. pumping finished products through a pipe line from point of storage to point of delivery. Worthington 5 x 10 KMS-1 power pumps are used, discharging against a pressure of 500 psi. Two 4½ x 12 KUF pumps are used when the discharge pressure is expected to near 1000 psi.

2. handling such duties as still reflux service, still transfer service, deethanizer feed, deethanizer reflux, depropanizer reflux, debutanizer reflux and condensate pumping. Worthington Hivol pumps of various sizes are used.

3. providing the power for the plant's entire electric requirements. Four Worthington DDG-8 natural gas engines are used, driving 525 kw generators—all units being derated for 3000 ft altitude.



Worthington power pumps at Shell's Notrees plant.



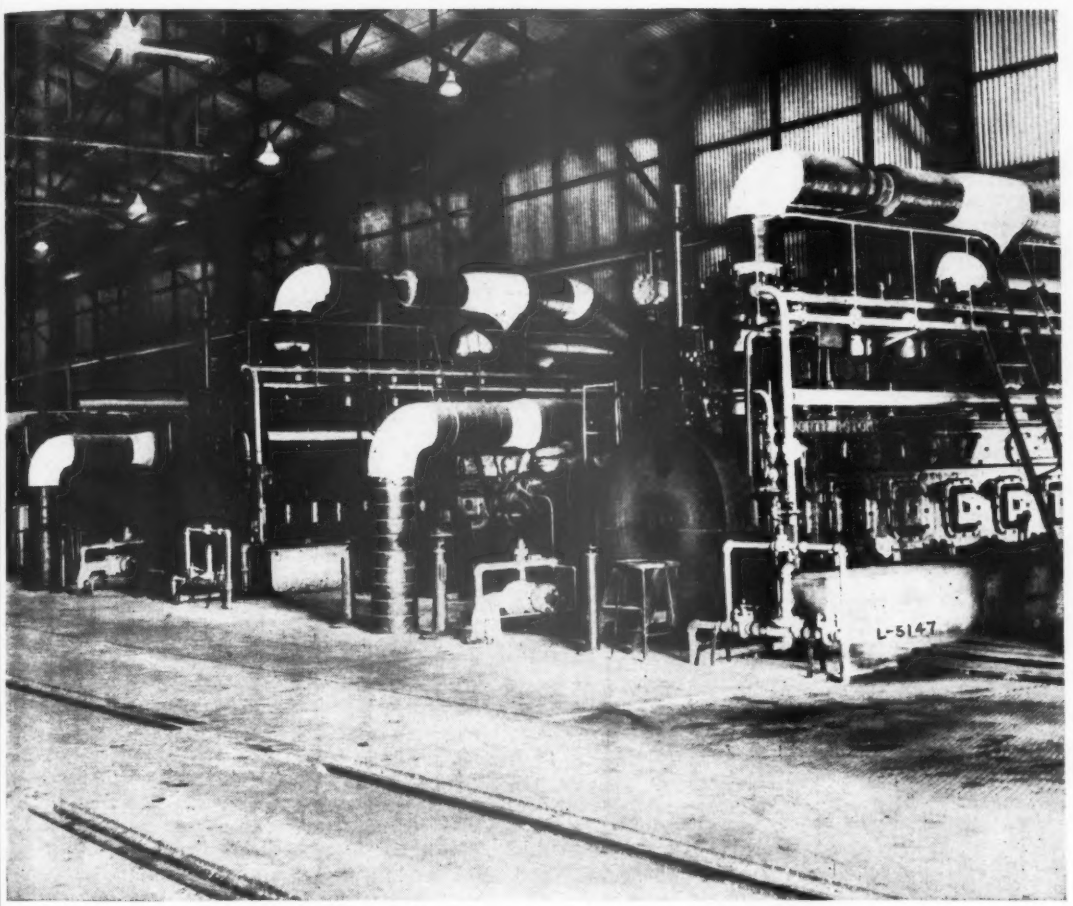
Worthington Hivol pumps on various duties.

Loading Cargo at 5,000 GPM

At the Union Oil Company's Oleum Refinery in California, two Worthington No. 12 GR Rotary Pumps with 450 hp motors and gears, are pumping over 5,000 gallons of fuel oil per minute, from elevated storage tanks down to the tankers at the docks. The pumps are handling grades of fuel oil up to No. 6.

Worthington Pumps loading cargo at Union Oil Company's Oleum Refinery. →

petroleum NEWS



Worthington Angle Gas Engine Compressors at Lion Oil Co.

War Veterans Still Operating Near Full Load

Five Worthington Ammonia Refrigeration Machines, and six Worthington Air Compressors, installed in February, 1942, at a plant then operated by Ozark Ordnance Works, are still running at near full load at the same plant, now owned by Lion Oil Company, Chemical Division, at El Dorado, Arkansas.

This plant, possessor of an exceptionally fine war production record, continues to operate at its efficient wartime peak, producing anhydrous ammonia and nitric acid.

The Ammonia Compressors are 2/2/13/13 x 15, compressing NH_3. The Air Compressors are 29½/29½/19½/19½ x 15. Two additional ammonia compressors are on order for a plant expansion program now under way.

Pressure Application

Two Worthington 5½ x 10 in. pumps being used on a pressure application in a Southwest refinery, pumping oil to the main line.

Worthington Pump and Machinery Corporation

•

Harrison, N. J.

3

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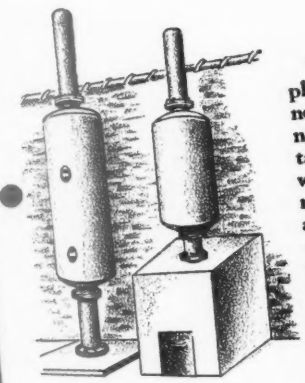
Keep it Quiet!



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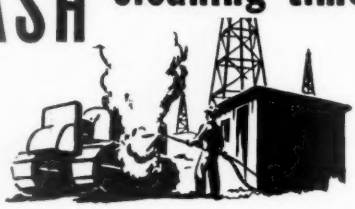

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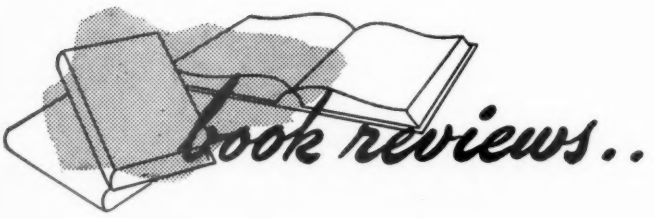

▸ **Abstracts of Current Literature on Synthetic Liquid Fuels, October, 1944 through December, 1945.** *Vol. 1. Abstract numbers 1-1005. Hobart Publishing Company, Box 4127, Chevy Chase Branch, Washington 15, D. C. Pages, 290. Price, $12.50.*

Originally prepared by the U. S. Bureau of Mines for internal use of its Fuels and Explosives Branch, these volumes are now available to the public. Years 1946 and 1947 are bound separately. The material was secured from technical publications of United States, Britain, Russia, Germany, Switzerland, France, Japan, and others. Patents of all countries are also abstracted. Each abstract is fully explanatory and as complete as possible. The contents include: Gas generation, Fischer-Tropsch process, Bergius process, refining of crude oils, analysis, instrumentation, and other material.

▸ **Guide to the Geology of Central Colorado.** *Quarterly of the Colorado School of Mines, Vol. 43, No. 2. Department of Publications, Colorado School of Mines, Golden, Colorado. Pages, 176. Price, $3.*

Published as a guidebook for the three field trips of the 33rd annual meeting of the AAPG, this Quarterly includes a large index map of Colorado that shows the major geologic structures and significant oil and gas information.

In addition to discussions of principal features of the field trip areas, and road logs for the trips, there are articles on the geology of the eastern flank of the Front Range, the Climax molybdenite deposit; the oil shale deposits in the vicinity of the Naval reserve, Garfield county; the Rifle Oil shale demonstration plant, and the geology of South Park. Thirty-eight figures and 14 plates aid in description.

▸ **Eruptive Rocks,** *by S. James Shand. John Wiley and Sons, 440 Fourth Avenue, New York. Pages, 488. Price, $7.50.*

In this third edition Professor Shand reiterates his treatment based on the chemistry of silicate systems, as opposed to the old concept of "natural rock type." New material and illustrations have been introduced and all is arranged for convenience of reference.

Three entirely new chapters discuss the link between eruptive rocks and certain types of ore deposits. Chapters cover temperature and pressure, freezing of silicate melts, and rock magma, late-magmatic and post-magmatic reactions, the genesis of pegmatite, classification, a system of petrography, and oversaturated rocks. Part 2 consists of rock descriptions. Four plates and 51 figures are a visual aid.

▸ **Statistics of Oil and Gas Development and Production, 1946,** *by the Petroleum Division of The American Institute of Mining and Metallurgical Engineers. 29 West 39th Street, New York 18. Pages, 480.*

Reports on operations within the United States provide essentially complete coverage of production and drilling activities. Tables on each state give the field history, area, cumulative production, and 1946 production. Number of wells, pressure, secondary recovery, producing formation and deepest zone tested are all included.

Twenty foreign countries are represented in this new volume which has expanded with the cessation of war. These reviews are in the main brief summaries, with maps and tables for countries of greater petroleum importance.

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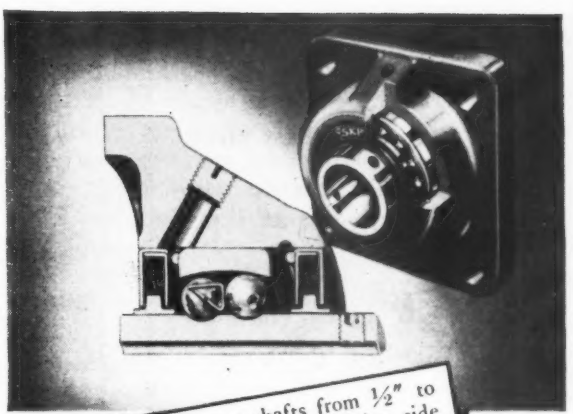

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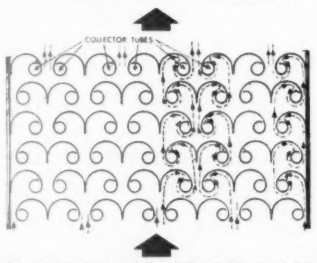

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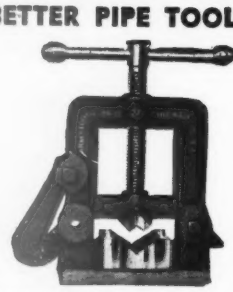

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Industrial Relations Adviser

Frank Pickell, manager of industrial relations for Stanolind Oil and Gas Company, has been named advisor in industrial relations for the company. Robert S. Newhouse succeeds him as manager of the industrial relations department.

Pickell, veteran Stanolind production and industrial relations man, has managed the company's employe relations program for five years. He joined Stanolind in 1931 and in 1942 was made superintendent of operations.

Newhouse, a graduate of Washington University, comes to Stanolind after nine years on the staff of Industrial Relations Counselors, Inc., New York City.

He was associated with Kroger Company for 10 years.

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Well Servicing Companies and Lifting Costs

THE growing importance of well servicing companies of all kinds as a means of reducing lifting costs is often overlooked by many operators or considered by others a routine result of high pressure salesmanship by some of those engaged in the well servicing business. Never before in the history of petroleum production, however, has the need for and the use of well servicing companies been greater than it is now.

Although some well servicing companies have become highly specialized, well organized big businesses in their own right, the term, "well servicing companies," as used here is meant to include all companies, local or international, that provide oil companies or oil well operators with special services connected with the location, drilling, and operation of oil and gas wells, such as surveying contractors, geophysical and geological contractors, core drilling or shot hole contractors; aerial and ground mapping companies; water supply contractors, drilling contractors, welding contractors, slush pit, digging and roadbuilding contractors, trucking and teaming contractors, rig building contractors, diamond coring contractors, core analysis companies, casing contractors, cementing companies, electric logging companies, radio-activity and other kinds of hole and formation surveying contractors, casing perforating service companies, acidizing and other well treatment and completion work contractors, and directional drilling and fishing companies.

Then, there are the well servicing companies that take care of the wells from the time they are completed to the time they are abandoned, including: bottomhole pressure and gas-oil ratio measuring companies, oil and gas well operating contractors, well pulling and workover contractors, contractors that keep wells and flowlines from becoming plugged with paraffin, tank cleaning contractors, salt water disposal companies, waterflooding and gas repressuring companies, and many others.

Many of these well servicing companies are still local in character, having been organized by the operators of a particular field. Others are national or international, having been developed from the patent stage to actual practice.

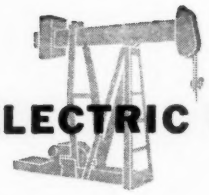
Regardless of their character or scope, however, all these well servicing companies are filling the operators needs for faster, more effective, and more economical exploration, drilling, and producing practice through the design and use of highly specialized, mobile units and highly trained personnel for performing the surface and subsurface work required in all wells, especially in the 5,000 to 18,000-ft deep wells that are common today.

All operating companies, large and small, benefit by the use of the facilities offered by most of these well servicing companies without having to worry very much about their upkeep or future existence. The managers of these well servicing companies, on the other hand, cannot afford to maintain their services and facilities in areas that are too small, too isolated, or otherwise too poor to keep them busy and profitable. Thus, we see many of these servicing companies moving from field to field as the age and condition of the wells change. We also see servicing companies prosper and fade according to the needs of the time and place, and their ability to keep abreast of these needs. Most well servicing companies and contractors are acutely aware of their responsibilities to their customers. Realizing their susceptibility to competition, they usually do everything possible to improve their service and reduce their charges.

The operators and the ultimate consumers of petroleum products are indebted to all the well servicing companies that have and are making it easier and cheaper to explore for, drill wells into, and produce our great petroleum reservoirs. Without these companies and the free competition among them, it would be well nigh impossible—at any price—to find, drill, and produce the huge quantities of oil and gas that means so much to the high standard of living in America.

Continuous employment of these well servicing companies at a steady rate should enable them to maintain their equipment and improve their effectiveness in reducing the lifting cost of oil.

K Marshall Fagin



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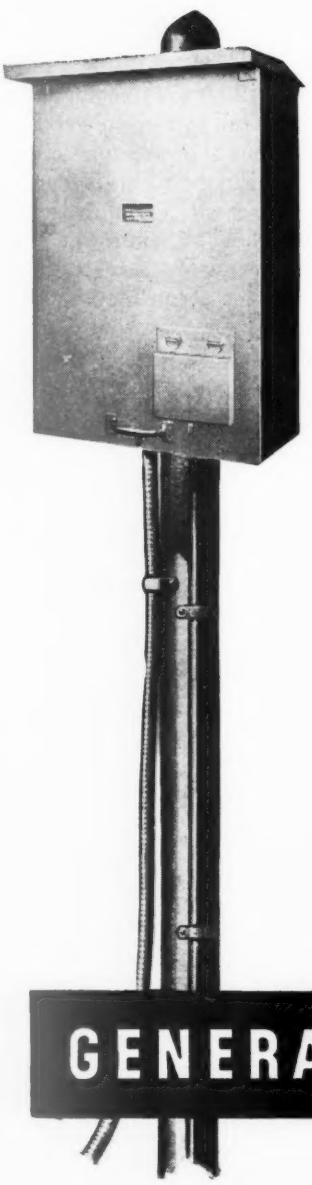

With a G-E electric well-pumping drive, you don't run up excessive production losses or maintenance costs caused by starting delays—no matter what the weather. Electric motors—with no water or gas lines to freeze up—need no babying or tuning up to start. They're protected against heat by air-cooling, against dust by sealed bearings, and against corrosion by cast-iron enclosures.

G-E pump controls, too, minimize any operating or maintenance problems. Time switch, magnetic starter, and protective devices—all are housed in a well-ventilated, weatherproof case. The starter can't overheat in the hot sun and prematurely kick the motor off the line. This eliminates extra trips to reset the overload relays, gives your pumper more time for other duties.

Dependable, all-weather starting is only *one* reason why G-E electric pump motors and control help you produce more oil at less cost. Let a G-E engineer give you the full story. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

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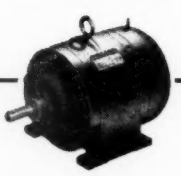
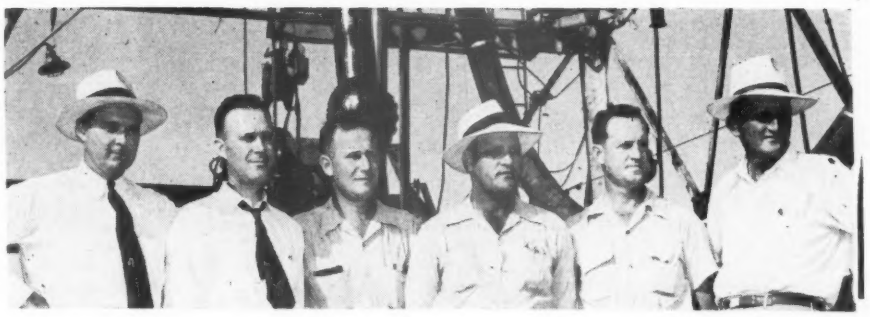




Key personnel connected with Humble's No. 30 are: T. J. Fuson, Gulf Coast division petroleum engineer; M. E. True, coordinator of equipment research, under whom the automatic equipment was developed. L. M. Duhon, Sugar Valley district petroleum engineer; G. W. Roberson, Sugar Valley district superintendent; A. R. Minscher, production geologist; and J. C. Greene, toolpusher.

Large Steam Rig Serves as Deep Drilling Laboratory

By K. MARSHALL FAGIN†

MOVED by the desire to design and develop drilling rig tools and equipment that will not only take a lot of drudgery out of the manual work involved in operating a rig but will also increase the efficiency of such operations by providing more scientific controls of the rotary drilling method, the Humble Oil and Refining Company of Houston, Texas, has assembled what is known as the "automatic" rig. It is basically a heavy duty steam drilling rig that serves as a field laboratory for the engineers, scientists, and drilling personnel assigned to its use in actual deep drilling operations in the Sugar Valley Field of Matagorda County, Texas.

Many kinds of power-operated tools have been designed and installed to assist the driller and the crew in the performance of the usual operations required to drill a well. The crewmen can rack a 90-ft thribble of 5-in. drill pipe weighing nearly a ton with a mere flick of their wrist. Even the derrickman is seated with only a control handle to operate. Remote control power tongs make up and break out drill pipe and bits.

The slush pumps can be turned off and on by remote controls on the derrick floor. Drilling mud is mixed by an opposed propeller device operated by a small steam turbine.* A new type automatic control adaptable to any feed-off device has recently been installed for use with the Humble-developed "walking brake." These, and many other pieces of equipment are being planned and developed on Humble's Rig No. 30.

▸ **Object of Field Research.** Humble's main objective in establishing this practical field laboratory for drilling research is simply to increase the safety and efficiency of deep drilling operations and thereby reduce the cost of drilling wells for the recovery of petroleum. There is nothing particulary novel about this objective. Manufacturers, other oil companies, and many trade and technical organizations have been working toward this objective for many years. Humble, however, is attacking the problems in a practical and emphatic manner, and the petroleum drilling industry should ultimately benefit from the experiments performed at this laboratory.

Reduction of time consumed in making round trips in deep wells will leave more time for drilling. Likewise, development of bits that will cut more hole in hard formations will reduce the number of round trips required. Improvement in the rate of penetration by the bit will decrease the time spent rotating the bit on bottom. Improvements in drilling mud control will reduce the time spent in circulating. These are some of the objects of the "automatic" rig project. Gathering data from actual drilling experience in the field should prove to be an excellent way to attain these objects.

▸ **Remote-Control Power Tongs and Pipe Racker.** With initial arrangements completed, work was begun on the remote-control power tongs and pipe racker in September, 1945. Field operating tests were begun on rig No. 30 in April, 1948. As finally developed, the tools are a joint development of Humble and Byron Jackson Company of Los Angeles, California.

Most of the physical effort of making round trips and drill pipe connections has been eliminated. The derrickman and tong operator control this equipment from comfortable seated positions. The driller has been relieved of operating the cathead and only operates the slips, hoisting engine, and brakes with air controls. The other rotary helper on the floor merely latches and unlatches the elevators.

Although the speed of pulling one stand with the new equipment is only a little greater than is possible with conventional hand operation, this speed can be maintained indefinitely regardless of hole depth, whereas fatigue slows crews working conventionally during long trips. Safety conditions are improved, as the derrickman need not move from his seat on the monkey board up in the derrick, and the tong lines and spinning chain are eliminated from the derrick floor.

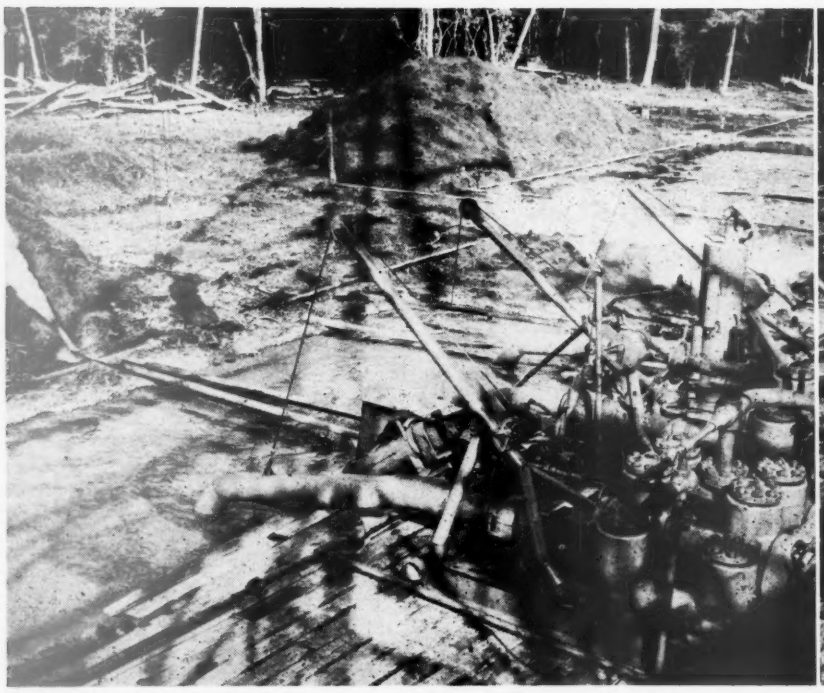
▸ **Remote Control Pipe Racker.** The remote control pipe-racker consists of two electrically-operated "arms," one at the monkey board, and one on the first girth on the ladder side of the derrick. The arms grip the pipe and move it to the desired spot on an elevated pipe platform when coming out of the hole, and pick it up from the platform and carry it to the power tongs when going into the hole.

The derrickman operates the upper arm, and the tong operator works the

*It is hoped by some that such a 10 hp mixer may eliminate the necessity for a third slush pump for mixing purposes.

†Field Editor.

EXCLUSIVE



The three large steam slush pumps have flexible connections into the suction pit. Note windlass-type booms for regulating depth of the suction pipes, and mixing action of the propeller-type mixer.

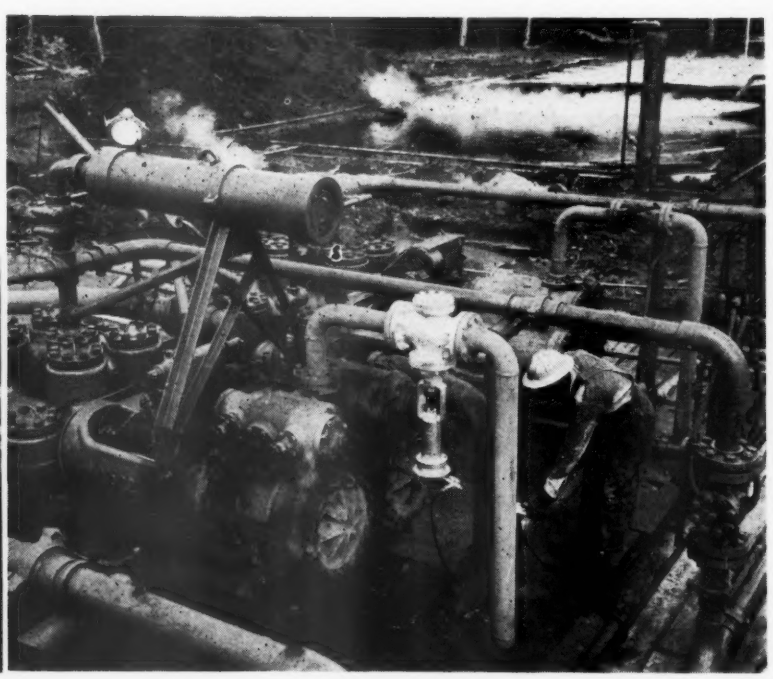
Slush pumps are started or stopped by remote-controlled pneumatic valves from toggle-type valve installation on derrick floor.

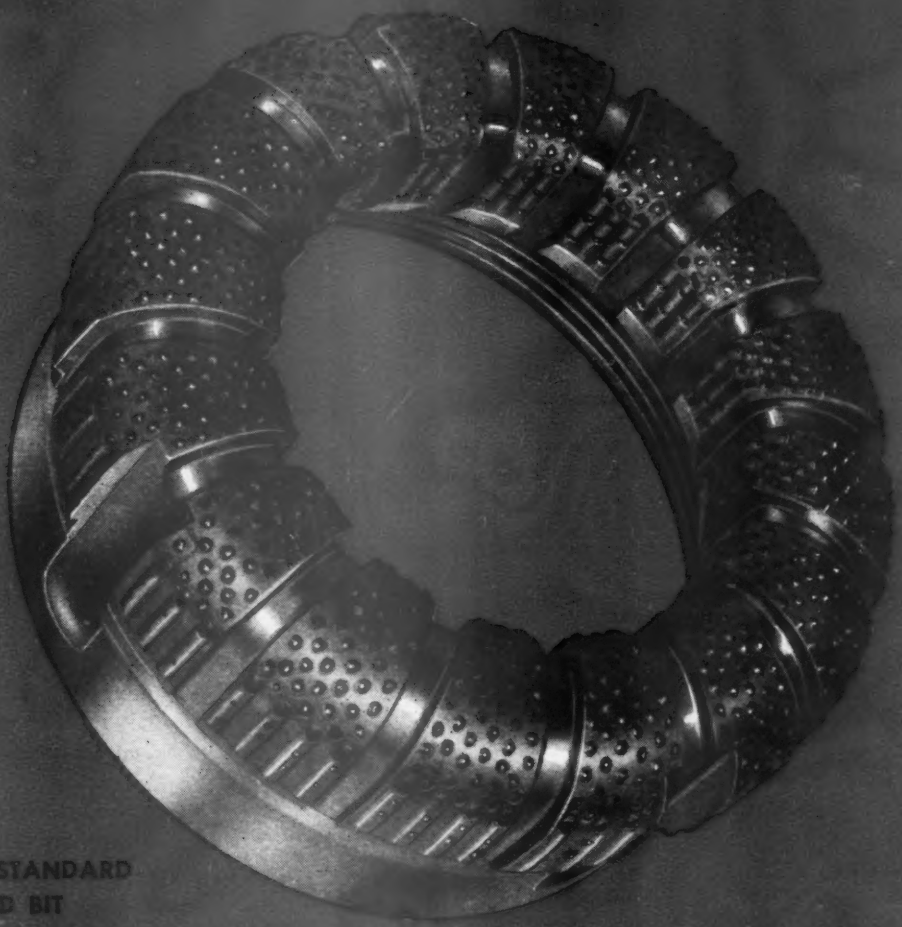
lower arm. Each arm is co1 trolled by a single control handle similar to the "joy stick" in an airplane. The handle is simply tilted in the direction of desired motion. The stand of pipe can be moved sideways at the same time that it is being moved toward or away from the tongs, thus permitting quick movement toward the spot where it is desired. A trigger mounted on the control handle releases the grip of the "arm" on the pipe.

The 12-ft racker arms are actually 3-in. lead screws, similar to those used on lathes and other feeding machines, which are moved by belt-driven nuts. The arms are powered by 3-hp 220-volt AC 3-phase electric motors. They can reach 10 ft out across the derrick. Keyways in the arm permit it to move without rotation as it is driven by the nut. A stationary lead screw mounted on the derrick gives lateral motion along the side of the derrick when a second nut rotates about it. A 2-hp 220-volt AC 3-phase electric motor drives the nut. The lead screws give 1-in. travel per 1/5 revolution of the nut, and move the arms at about 2 ft per sec.

Limit switches prevent the nuts from becoming fouled. The propulsion units are identical, except that the monkey board moves along the side of the derrick with the upper racking unit. Each racking unit travels on a

Right, slush pumps also may be started or stopped by manipulation of toggle-type valves situated near remote-controlled pneumatic valves on each pump. Below, the new opposed-propeller-type mud mixer is mounted on the edge of the suction pit. It is driven by a 10 hp steam turbine. Dry mud materials may be dumped in the hopper and sucked down into mixing stream created by action of propellers.





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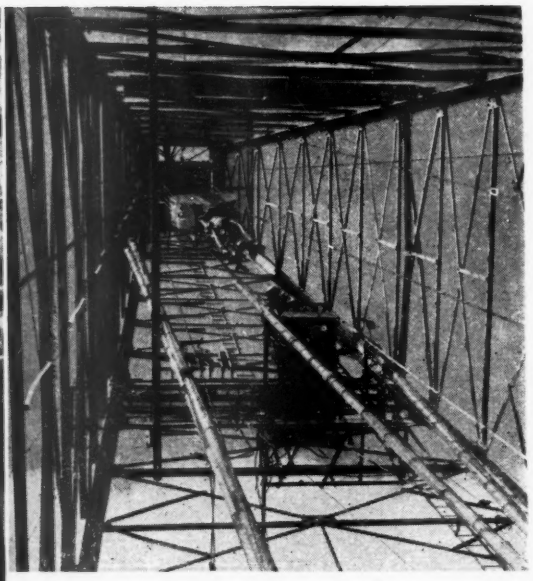

Above, the derrickman prepares to rack a stand of drill pipe with his movable monkey board and its automatic gripper arm.

Left, derrickman does not have to move from his seat in automatic monkey board, except to unlatch elevators when coming out of hole.

This is the only operation for which the derrickman has to leave his seat on the automatic monkey board — unlatching the elevators when coming out of the hole.

track constructed of 4-in. pipe reinforced with welded guide strips, allowing 8 ft travel for the monkey board and 10 ft for the lower racking arm. Control circuits are 110 volts AC.

A claw on the end of the upper arm grips the pipe on contact and is released by the control handle trigger. The "finger" of the claw is operated hydraulically by a solenoid valve. No weight is supported by the upper arm, and a safety shear pin permits the "hand" to rotate downward and release the grip should the arm become overweighted. The lower arm grip or "hand" incorporates an auxiliary elevator for lifting the stand out of the tongs and off the pipe platform. A parallelogram linkage on the end of the arm permits a maximum travel of 10-in. vertically, as the arm remains in the same place. This elevator is actuated by a push-button-controlled hydraulic cylinder mounted just under the monkey board and connected to the lower arm by a 3/8-in. wire line. The elevator is designed to support a 90-ft stand of 5-in. external upset, inside flush drill pipe weighing about 2,000 lb.

The steel pipe rack on the ladder side of the derrick floor is 5.2 ft above the floor and 4.6 ft above the

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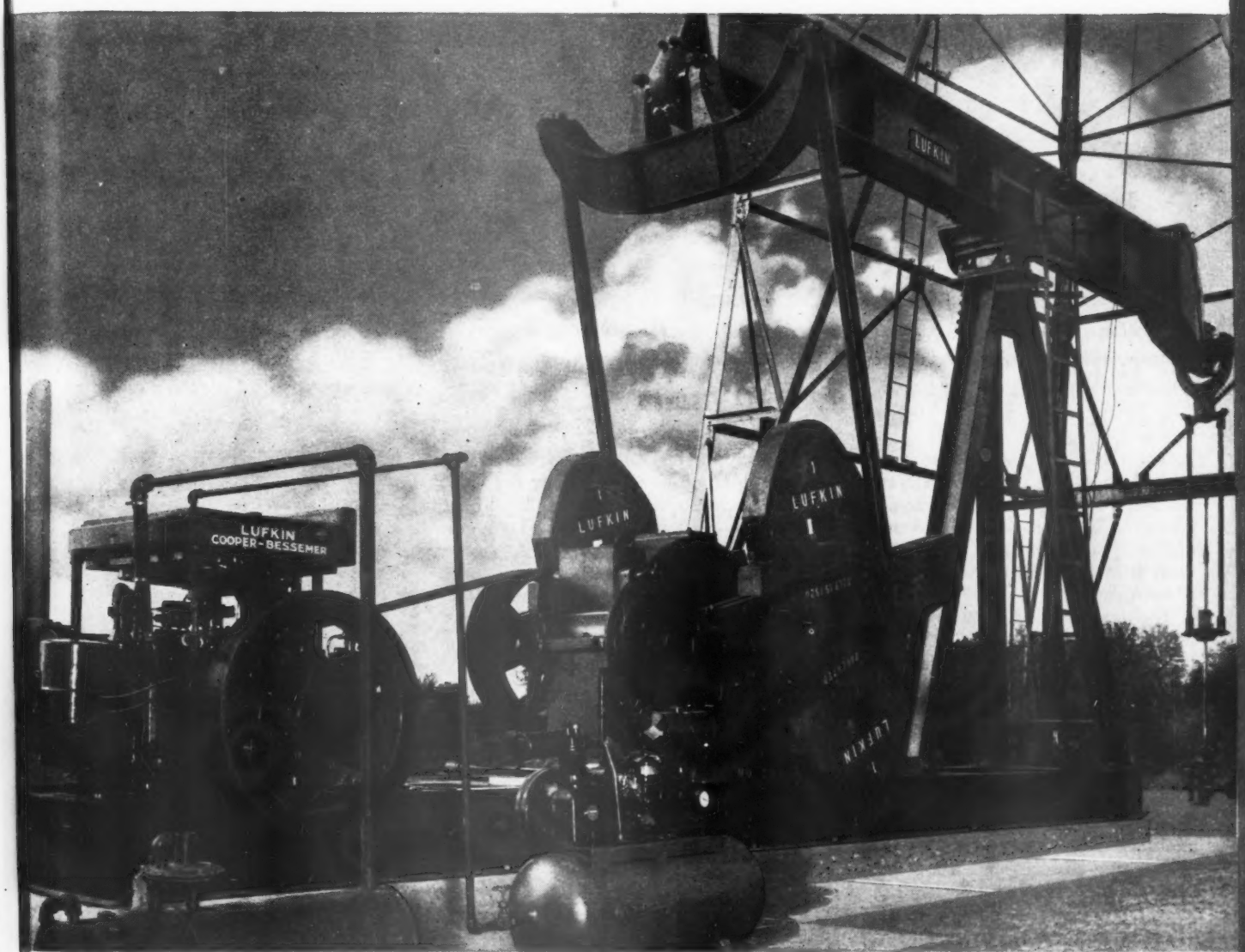

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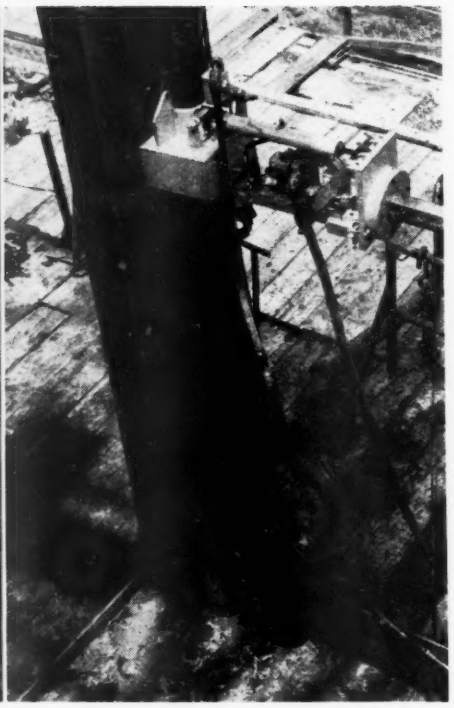
Operation of the slips is controlled pneumatically by the driller through remote control switch valves. Much drudgery is eliminated by such devices.



Stand of drill pipe being racked on the floor by gripping arm through remote controlled electric switches.

rotary table. The pipe is now being racked in a "hayrake" and fingers, normally racking 4 rows of 13 stands, 2 rows of 10 stands, 2 rows of 8 stands, and one row of 6 stands. Sixteen thousand ft of pipe can be handled in the present rack.

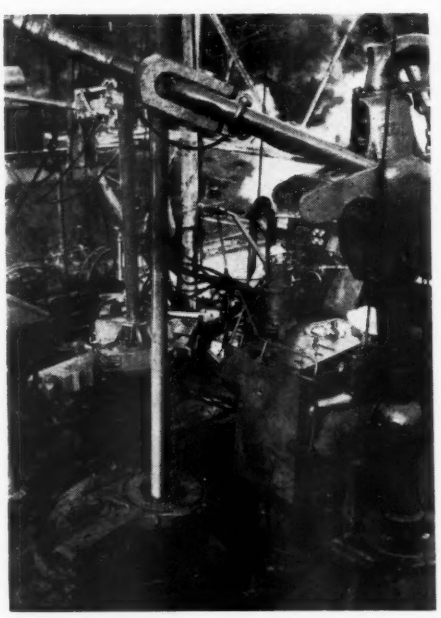
The monkey board is mounted on the upper racking unit, and travels laterally across the ladder side of the derrick. The board is equipped with a seat and handrails, the control handle and safety cutoff switch being located on the right handrail. The upper racking arm moves side-to-side with the monkey board, and the 10 ft travel of the arm is ample to provide automatic latching of the elevators. When manual racking is necessary, a 1-ft extension on the monkey board is raised in place, and the front handrail drops down to reinforce the extension.

▸ **Remote-Control Power Tongs.** Manual handling of tongs has been eliminated by the remote-control power tongs, which handle pipe from 2⅞-in. to 8-in. without adjustment. The hydraulic-powered tongs will make up, break out, spin up, and spin out pipe in that range with equal ease. The tong operator faces the driller as he controls these operations with 8 hydraulic valves mounted in the tong control box.

The power tongs, operator's seat, and control box are mounted on a 6-in. column mounted 4 ft from the center of the rotary on the drawworks side. The supporting column is bolted to the substructure and guyed to the derrick at the top. A hydraulic lift built into the column provides a 3-ft vertical travel of the entire unit, permitting operation at any height in that range and allowing the driller a tolerance in setting the slips.

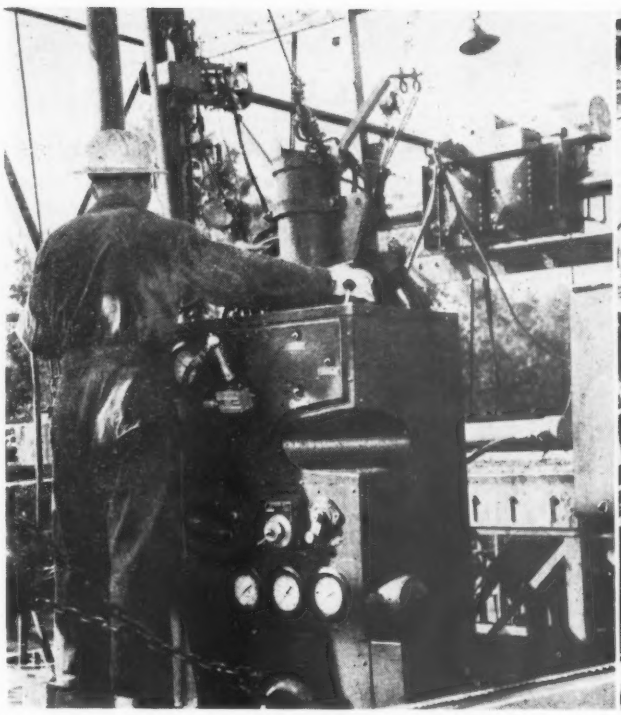
The tongs are in two frames, with the upper frame mounted to rotate 30 deg about the drill pipe center for maximum tonging. The two tong frames rotate together 180 deg about the supporting column on a 4-in. pipe arm. All operation is hydraulic, utilizing 8 hydraulic cylinders and one hydraulic motor to latch and unlatch the tongs, grip and spin the pipe, and carry it. The hydraulic motor develops 8800 lb-in. of torque and spins the knurled rollers at 80 rpm for spinning the pipe in either direction. A force of 15,000 lb is used against the rollers for spinning.

Maximum breakout torque is 1,600,000 lb-in., and maximum make-up torque is 800,000 lb-in. Normal operating pressure is 1500 psi, although 2500 psi is used for maximum torque. Hydraulic pressure is supplied by a 35-hp pump that is interchangeable with the spinning motor on the tongs. The pump is powered by a 4-cyl engine mounted on a skid located under the engine platform. The skid also contains the filters and a 150-gal hydraulic oil supply tank. The hydraulic fluid is turbine oil, and is filtered on return from the operating system.

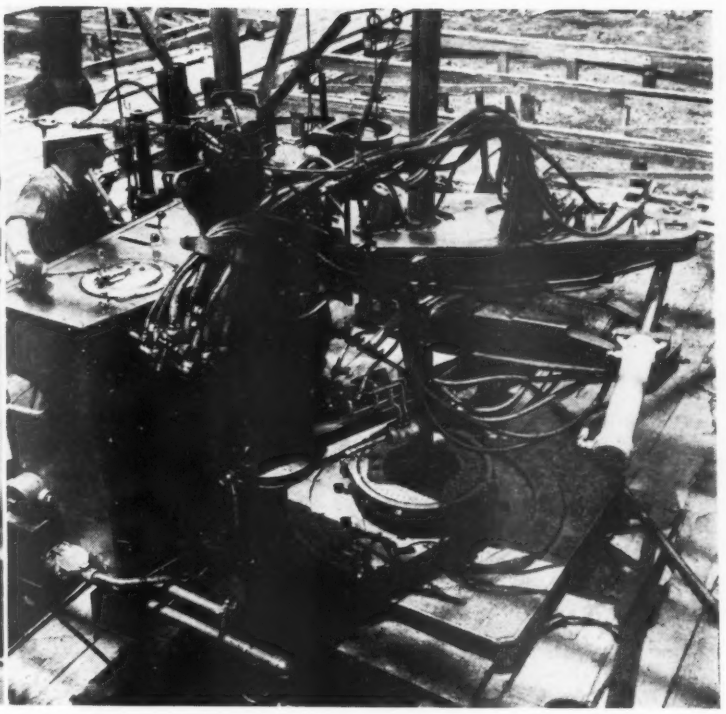


The kelly and swivel are placed in a vertical rathole so as to clear the automatic tongs when going in or coming out of the hole. Note the special hooking device on the top of the bale.

▸ **Operation of the Tongs and Pipe Racker.** The derrickman controls the upper racking arm from his seat on the powered monkey board. A



The automatic power tongs are controlled by the operator from a control box stand mounted on a pipe anchored through the derrick floor, which moves up and down and around with the tongs.



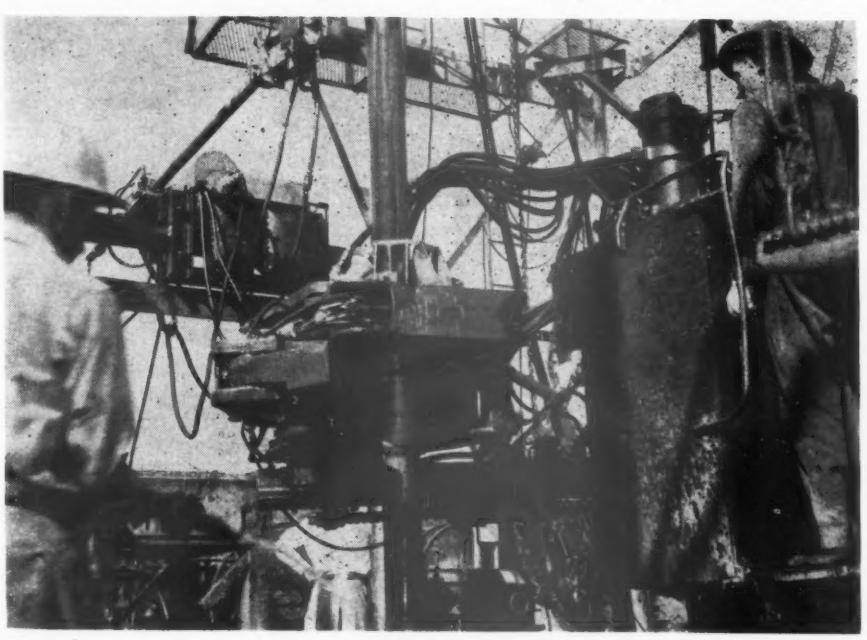
Multiple hydraulic hose connections are required from the tong control stand to the tongs. The rotary is used at present to unroll the connections after they are broken out, thus relieving tong operator.

movement of the drill pipe up in the derrick is by the racking arm, the derrickman's only manual operation being to unlatch the elevators when coming out of the hole. Even this hand operation will be eliminated when automatic elevators, now under construction, are completed.

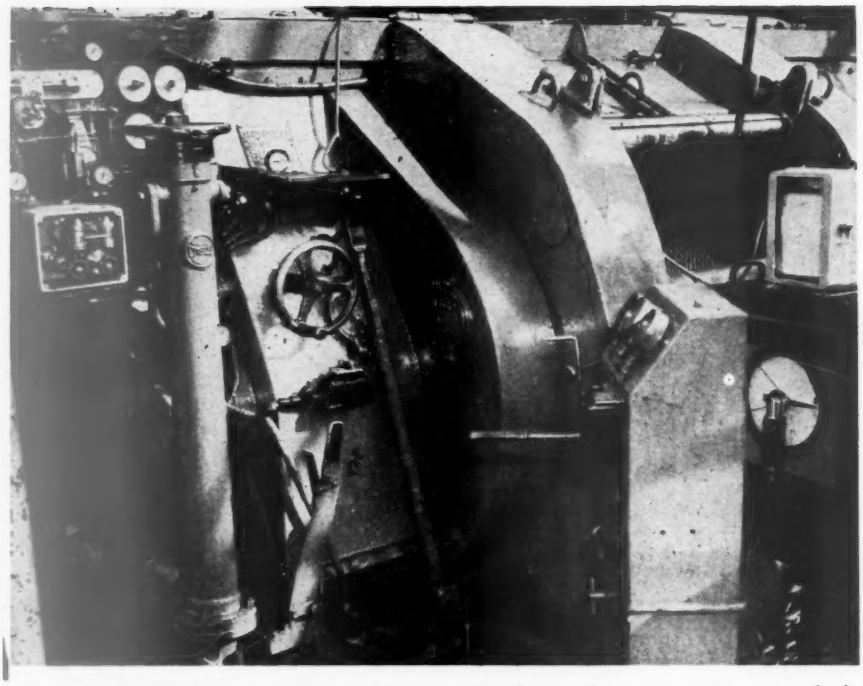
All tonging operations and pipe handling on the derrick floor are remotely operated by the tong operator. He controls each individual operation with 8 control valves and a racker control handle. The driller operates the drilling engine, air brakes, and air slips by air control valves. The rotary helper on the floor only unlatches and latches the elevators and washes the drill pipe.

Coming Out of the Hole. As soon as the driller sets the air slips after pulling a stand of drill pipe, the tong operator moves the tongs to the pipe at the proper height to engage the joint, and latches the tongs. The tong operator sets the grip, and the upper frame rotates 30 deg to break out the connection. The grip is released, the upper jaw takes the carrying grip, and the lower jaw is unlatched. The tongs lift the stands as the driller spins out the joint with the rotary. (The spinning may be done with the tong rollers, although rotary spinning is faster and relieves the tong operator of one more operation.) While the breaking-out operation is underway, the derrickman pulls the stand to him by means of his powered hook and manually unlatches the elevators.

As soon as the threads clear the tool joint, the stand is carried to the transfer position through a 51 deg arc by the upper frame. Both frames move together. This transfer position, about 4 ft from the rotary, is necessary to allow clearance for the traveling block. At the transfer position the lower racking arm, under the control of the tong operator, grips the pipe automatically on contact, lifts the



Here, the automatic tongs are being engaged to break out a connection. The rotary helper advances with a water hose to wash down the pipe.



The driller's position on the automatic rig shows the automatic control device (right) that enables the driller to carry a selected weight on the bit.

stand from the tong frame, and racks the stand in its proper place. The stand is carried with about 2 in. clearance above the pipe platform, and the drop to the platform is easy as the grip-release trigger is pulled. A push-button automatically returns the racker to the transfer position.

The derrickman racks the upper end of the stand simultaneously with the lower end. The driller lowers the block as soon as the derrickman unlatches the elevators, and the rotary helper latches the elevators on the pipe in the rotary.

Going in the Hole. Both racking arms pick up a stand and move it to the transfer position. (The auxiliary elevator on the lower racker arm supports the weight of the stand from the hydraulic cylinder mounted on the derrick.) The derrickman centers the monkey board and holds the pipe clear of the block. At the transfer position the auxiliary elevator lowers the stand into the front tong frame, which grips the tool joint. The operator then swings the tongs around and stabs the stand into the joint in the slips. The lower jaw is latched, and the stand is screwed up by the spinning motor. Both jaws then grip the pipe and the upper frame rotates 30 deg to provide final tightening. (This may be repeated to produce a tight connection.) While the tonging is in progress, the derrickman moves the upper end of the stand into the automatically-latching elevators. Tonging complete, the driller picks up to free the air slips, and then lowers the pipe into the hole.

By the time the pipe is lowered into the hole, the slips set by the driller, and the elevators unlatched by the rotary helper, the tong operator and derrickman have moved the next stand into the transfer position, and await the ascending block to clear the stand before repeating the process. By contrast with conventional operation, the block is run up and stopped before the pipe is pushed into the elevators by the upper racking arm.

Drill pipe connections are made with the power tongs using a special vertical mouse-hole directly in front of the driller on the tongs' operating arc. When the tongs are not in operation, they are swung out of the way in front of the drawworks.

Rotary table speed governor mounted on the drilling engine shown here is being oiled by the rotary helper.

Automatic Drilling. A new type automatic control adaptable to any make feed-off device has recently been installed for use with the Humble-developed "walking brake." This equipment permits the driller to set the weight he desires to carry on the bit on a dial, and the control unit automatically operates the feed-off of the brakes to maintain that weight.

The walking brake permits feed-off of the drilling line at a controlled rate. It consists of two independent air brakes, one on each drum of the drawworks, that are engaged alternately. Hydraulic cylinders are connected to each brake that permit the brakes to rotate a short distance with the drum. The speed of rotation of the drum is controlled by varying the restriction of the hydraulic fluid flow from the engaged brake side to the opposite hydraulic cylinder. The brakes "walk," because only one is engaged at a time. During a trip, the driller's air control handle operates both brakes together as in conventional braking.

Although maintenance of the proper weight on the bit for a given formation tends to keep it digging at its fastest rate, some formations are too irregular in hardness and drillability to gain much advantage by setting a constant weight. The possibilities of twisting off the drill pipe due to excess weight are reduced, however, and holes are often straighter than when the weight on the bit is controlled by manual braking.

The importance of maintaining an automatic feed and uniform weight on the bit usually increases with depth, because (1) the formations are uniformly harder, (2) the drill pipe driving the bit is under greater stresses, and (3) round trips are more time-consuming. Heavier equipment for deep drilling is less sensitive to the feel of the operator. This makes automatic control even more important with greater depths.

Rotary Speed Governor. Constant rotary speed, in addition to uniform bit weight, is often essential to attaining the most economical drilling rates. A new type of governor is attached to the engine throttle on rig No. 30 that maintains the rotary speed constant within close limits, so as to provide the proper weight and speed rotation ratio. Use of the governor is designed to prevent damage to the drill pipe or the rig due to overspeeding as well as to contribute to drilling efficiency. ★ ★ ★

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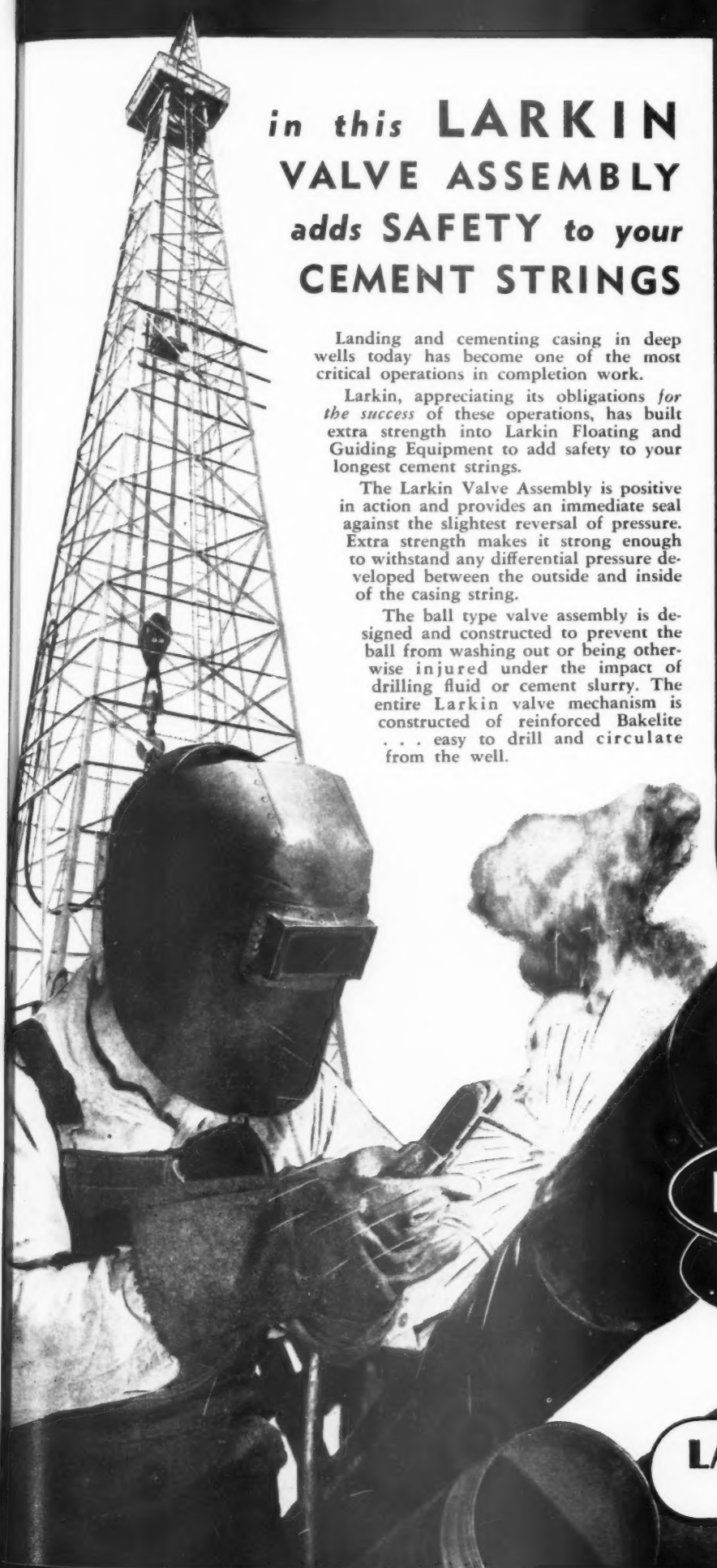

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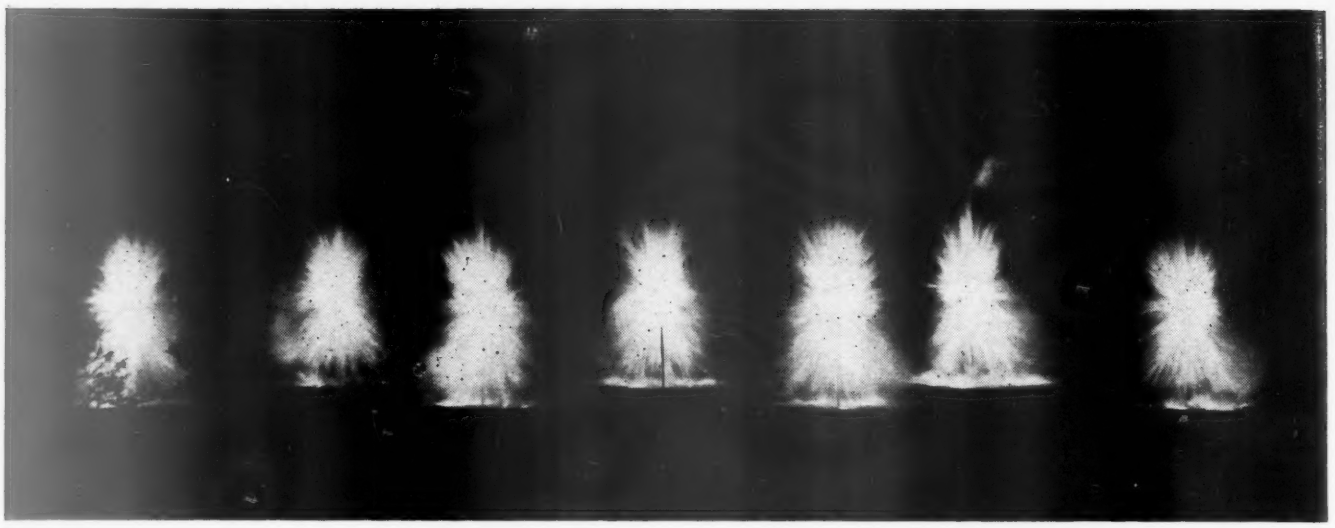

FIG. 1. Night explosion of seven-charge pattern used in new method of seismic exploration developed by Institute of Inventive Research, San Antonio. One of several types used, explosion shown in picture covers area of 70 ft with shaped charges in a hexagonal pattern.

Above Ground Detonations Used in Seismic Exploration

The Institute of Inventive Research of San Antonio, Texas, recently announced that a new method of seismic oil exploration developed by Thomas C. Poulter* had reached an experimental stage where results appeared most promising. The method in one form employs a pattern of small, specially-shaped charges of explosive compositions that are detonated above ground as contrasted with conventional methods of firing a single, large charge in a shot hole at various depths beneath the surface. The advantages of eliminating shot hole drilling are immediately apparent. The method has been tested and checked against records obtained by conventional methods in both proved and unproved areas of Texas, Oklahoma, and elsewhere.

The charges in the explosive pattern are set up on stakes relatively close to the ground and spread in a hexagonal design of seven, 13, or 19 points, with one in the center, over a selected location. Depending on the type of records sought, comparatively light charges are placed from five to 85 ft apart and detonated simultaneously. Tests have shown the above-ground explosion method, on which patents have been applied for, does not incur the risks of the shot hole method as regards damaging nearby structures of concrete or other solid material. It also eliminates the danger of falling stones. The Poulter method, however, produces a louder explosion than the shot hole method, although its concussion effect is almost negligible.

Poulter has made the following observations about the new method:

As is the case with many technical developments today, the idea of producing a seismic wave in the ground by means of an explosion in the air is not new. The development of this method of geophysical seismic explorations, although a direct outgrowth of observations in the Anarctic, has involved a great many fundamental studies.

Studies were made of the manner in which the energy from an underground explosion was absorbed and it was found that as much as 85 per cent of the energy may be absorbed within a few feet of the charge through the work done in crushing the rock or other surrounding material. A study was then made of the further absorption of that portion of the energy which is converted into a seismic wave motion in the ground. In order to reduce the problem to its simplest form, studies were made on the transmission of sound on seismic waves through dry sand of a uniform grain size. These tests showed that there is very little absorption if the amplitude or inten-

**THOMAS C. POULTER, PH.D., D.Sc., Associate Director of Stanford Research Institute, received his Doctor of Philosophy degree at the University of Chicago. He served as second in command and senior scientific adviser on the second Byrd Antartic Expedition (1933-35). He has twice received the Congressional Medal of Honor. From 1936 to 1948 he was Associate Director of the Armour Research Foundation. He has been head of the division of mathematics, physics, science and astronomy at Iowa Wesleyan College. He is an authority on organic chemistry; electrical, chemical, physical, and optical effects at extremely high pressures; Antarctic meteor and auroral phenomena; geophysics; glaciology; terrestrial magnetism; and seismology.*

In the summer of 1947, Dr. Poulter presented a plan for researching his concept of a more economical method of geophysical seismic exploration to the Institute of Inventive Research in San Antonio. The Institute, a non-profit public service organization endowed by Tom Slick, Texas oil man and rancher, provides a complete processing service to inventors in return for a share in possible proceeds. The staff of the Institute examined Dr. Poulter's proposal and approved it as a research project, arranging to retain Dr. Poulter to conduct the experimentation necessary to determining its value and practicability.

Since then, Dr. Poulter has been engaged continuously in this work, developing the project in various proved and unproved terrain in Texas, Oklahoma, and elsewhere.

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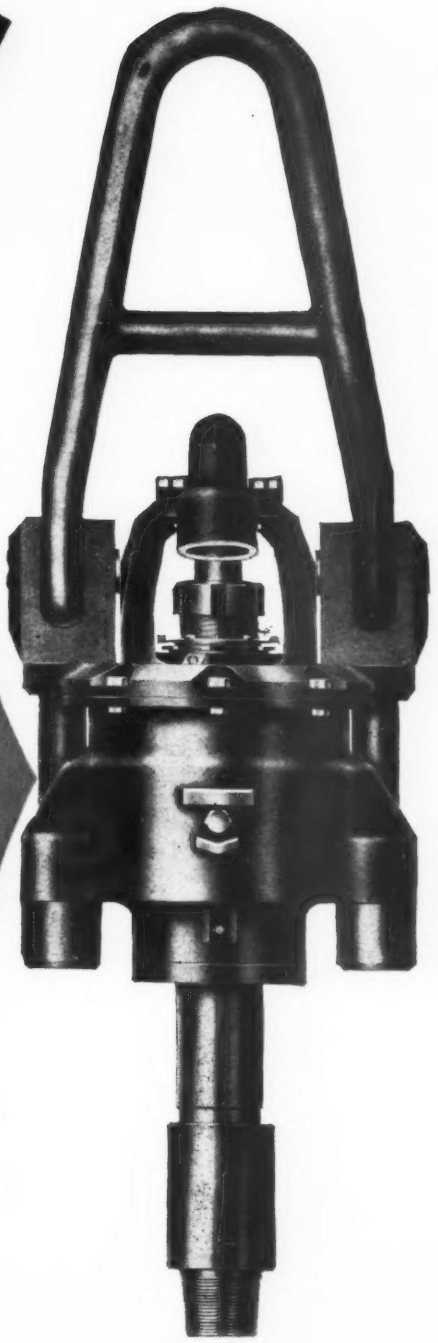

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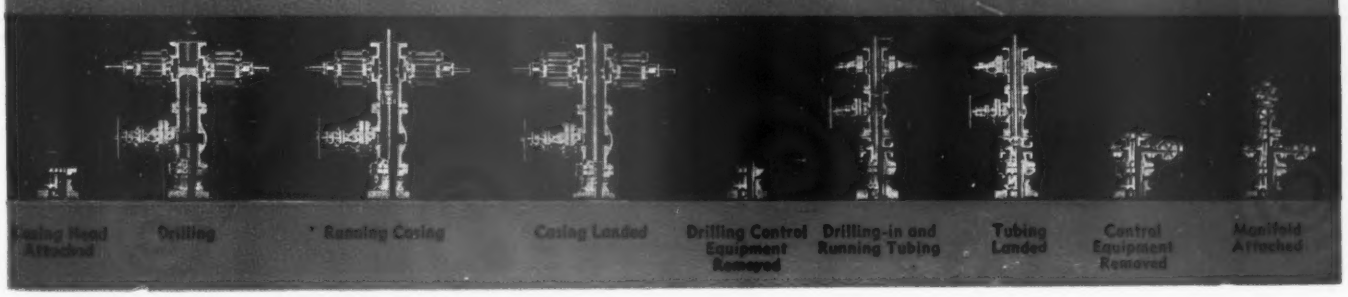


sity of the sound is very low. In other words, if the intensity is very low, 95 per cent of the energy may be transmitted whereas if the intensity is high, as little as 5 per cent or less may be transmitted.

It was further found that, other things being equal, the larger the particle size, the greater the intensity can be before the absorption becomes excessive. For a mixture of particle sizes such as is found in the weathered layer, the absorption covers a wider intensity range, but in all cases if the amplitude of the wave motion or its intensity is sufficiently low, the seismic waves will be transmitted comparatively well.

In seismic exploration, the term weathered layer has been applied to a layer of the surface of the earth where the particles are not compacted into a solid mass and, as a result, if an explosive charge is buried just beneath the surface, so much of the energy will be absorbed in the weathered layer that there is not enough left to penetrate to the desired strata and reflect back even though the transmission characteristics of the underlying strata may be very good.

This does not mean that if the intensity at a point on the surface of the ground is reduced sufficiently, good records will be obtained. As this energy travels out from a point, its intensity decreases at a rate that is inversely proportionate to the square of the distance from the source. This is in addition to the absorption phenomena mentioned above. If, however, the wave front is flat instead of spherical, there is no decrease in intensity as a direct result of increasing distance from the source.

One of the most effective ways of minimizing the loss of explosive energy with an accompanying increase in the efficiency of converting it into a seismic wave motion, is to detonate the charge in an elastic medium such as air and permit the wave motion to travel a sufficient distance in that elastic medium so that the amplitude or intensity has diminished to the point that it will transfer to another medium with only minor loss of energy by absorption. Because the air is so elastic, the total energy in the air wave remains almost constant even after it has traveled for long distances.

By this method of exploration, charges are detonated at or above the surface of the earth. This sets up an air wave of very high intensity, but since the air is highly elastic even at such high energy levels, very little absorption occurs. This air wave is allowed to travel far enough through the air so that this energy is spread out over an area large enough that the ground will receive and transmit it with a minimum amount of absorption.

Fortunately the three most important sources of loss of energy encountered by the conventional method are removed by the single expedient of detonating a series of properly arranged charges at or above the surface of the earth. By detonating the charges in air very little energy is absorbed in the immediate vicinity of the charge. By applying this energy simultaneously over a relatively large circular area of the earth's surface, the energy per unit of area may be small but the total energy can be made quite large, and the fact that this automatically produces a flat wave front tends to minimize the inverse square loss.

Numerous methods for producing a flat wave front over a large area have been studied and several methods have been developed. One of the methods used effectively was a modification of the Munroe effect, or lined shaped charge, which had proved to be such an effective weapon during the war. This charge was modified in such a way that instead of producing a long narrow jet, it produced a symmetrical umbrella shaped jet by means of which it was possible to produce an essentially flat wave front 80 ft in diam. Although good reflections can be obtained in many areas by this method using a single charge, other types of charges, fired either singly or in multiples, have been found to be more convenient in actual field operation.

If a flat circular charge of high velocity explosives is suspended several feet above the surface of the earth and in a horizontal plane, and this charge is detonated from the center, it will produce an essentially flat wave front over a circular area more than a thousand times the area of the charge. These charges can be fired singly or in multiples of uniformly shaped charges depending upon the difficulty or ease with which energy is transmitted through the weathered layer and the characteristics of the sub-strata.

Because of the velocity at which this wave front travels it is necessary that all of the charges be detonated within an elapsed time of not more than one ten-thousandth of a second. Several methods of doing this have been worked out whereby either the standard seismic caps can be utilized by using a modified or different type blasting machine, or by using the standard blasting machine and a modified blasting cap.

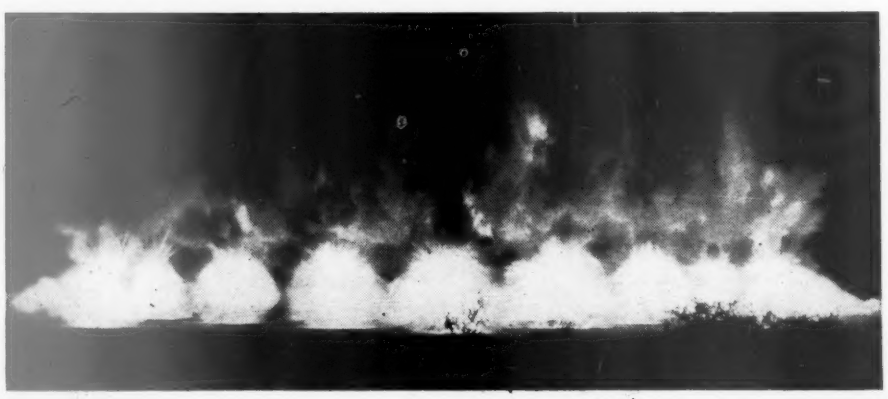
No modification of any kind is required in the standard seismic equipment, but since no drilling equipment is required, the procedure of operation is made more flexible, the shooting party can work more closely with or even be combined with the surveying party, and if it is found that additional shot points are desirable they can be introduced without the necessity of having each of the three groups return to that point.

It has another advantage in that several shots can be made at the same shot point to obtain comparable results without the variation that occurs in successive shots in a hole, or the danger of losing the hole completely and having to have the drillers return to drill another hole to be shot later.

Of course the more important advantages of the method are obvious: namely, the saving of the cost of drilling shot holes which in such areas as West Texas may range from $5,000.00 to $20,000.00 per month per party. Equally important is the greater rate at which a party can obtain data.

* * *

FIG. 2. Night explosion of 13-charge detonation covering 120-ft area, with special shaped charges in hexagonal pattern with one in center.



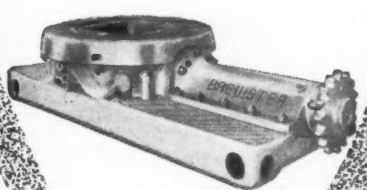
FOR SHALLOW DRILLING AND DEEP WELL SERVICING

BREWSTER 70-B DRAWWORKS

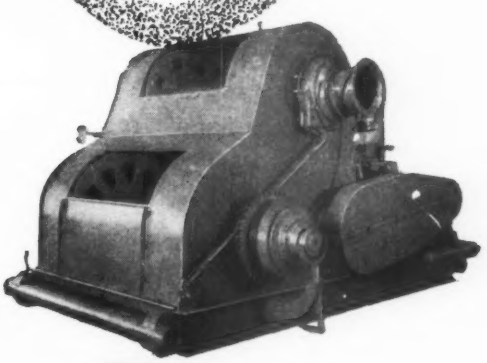
WITH MATCHED EQUIPMENT

50-Ton Block

3-S Swivel



OB-12-L Rotary



The Brewster 70-B Drawworks is fast to move, fast to rig up, and fast in operation. It is rated for drilling to 3500′ with 4½″ pipe, and servicing to 7000′ with 145 H.P. engine.

Low and compact in design, the 70-B has friction clutches throughout for easy, flexible control. Also available in double drum model shown at right.

Write today for complete information—ask for Catalog 108PE.

THE BREWSTER CO., INC.

Manufacturers of Drilling Equipment Since 1910
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BREWSTER
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What Leduc Means to Canada

By H. G. COCHRANE

THE Province of Alberta, Canada, is today in the center of an oil boom that extends throughout the Canadian West. From the eastern foothills of the Rockies to well into Manitoba, from the International Boundary north to Slave Lake in the Northwest Territories, exploration is proceeding at an unprecedented rate. Oil rights from under more than two million acres are changing hands monthly. A force of more than 4000 men were engaged last summer on exploration in Alberta alone. Fifty-four geographical and core-drilling parties were out on survey. Almost every oil company on the American continent is taking a hand. Footage drilled in 1947 was double the previous year, whereas for the first six months of 1948, almost four times as much footage was drilled as in the same period of last year.

There are two main reasons for the present activity. The first is the discovery made by Imperial Oil, Ltd., 22 months ago at Leduc, some 20 miles south of Edmonton, and the almost unbroken series of successes in bringing 130 wells into production since. The second reason is Canada's critical shortage of Canadian produced crude oil, and her desperate shortage last fall of U. S. dollars as well, needed to purchase it from American oil fields. Yet behind it all is the dogged search for oil over half a million acres of Canadian prairie that began back in 1919 and involved more than 120 miles depth of exploratory drilling, most of it by Imperial.

Not like oil boom of thirties. Interest in the present oil activity is centered around Leduc, for here is the hub of Western Canada's second oil boom. The earlier one, which took place in the middle "thirties," was based on Turner Valley, some 40 miles south of Calgary. The two developments are vastly different. Turner Valley grew slowly, starting with a few wet gas wells. Interest on the part of large operators at first was slow. Financing was accomplished largely by local operators through sale of stock to the public, similar to methods successful in developing Canadian gold mines. Brokers collected money in waste paper baskets from eager investors who had climbed ladders to enter trading rooms through upstairs windows. Turner Valley, however, is now a declining field. Production which rose to an annual rate of some 10,000,000 bbl in 1942, has since declined to a little more than half that rate of output.

Petroleum engineer, Bob Mathewell, turns valve on separator line at an Imperial Oil well in Leduc area after well was brought into production.

Leduc, on the other hand, is a "big operators" field. Three-quarters of the producing wells are operated by Imperial Oil, the rest by independent companies. Increase in trading in oil shares due to Leduc's activity is negligible. Interest in leases and oil royalties has taken its place. Today there are some 38 wells drilling, two-thirds of them by Imperial, at the Leduc field alone, and completions are currently at the rate of about 20 new wells a month. This progress has brought in a rate of production surpassing Turner Valley's present output by 3000 bbl a day, whereas by mid-1949, if maintained and even if not exceeded, production should exceed Turner Valley's peak rate of output of 1942.

EXCLUSIVE

Description of field. Leduc is producing light oil (40-41 gravity), comparable to the Turner Valley product, although with lubricating qualities far superior to the latter. It compares favorably with mid-continent U.S. crudes. It comes from two separate zones of porous Devonian limestone, the "D2," 26-2700 ft below sea level, and the "D3," 2900-3000 ft below sea level. Of these the D3 zone is found to be the more prolific. Many of the wells are oil bearing in both zones. The limits of both zones are partly defined on the east, but limits in other directions are yet to be determined. Thus far the limits of the field are about 5 miles east and west and 4

Christmas

During 1948 the discovery of new crude oil fields and new oil producing formations totaled approximately 850 —*over one every 12 hours!*

Core Lab's *combination* service of Drill Cuttings Analysis (well logging) and On-Location Core Analysis, both performed simultaneously at the well site by the *same* crew using the *same* portable field laboratory, contributed greatly to these successful operations.

Stop and count the advantages of this exclusive service. 1 — *You "see"* each foot drilled. 2 — *You core* only those few feet, out of the total depth, which indicate probable production. 3 — *You receive* an immediate analysis of formation physical characteristics and fluid content on each foot of analyzable core recovered. Drill Cuttings Analysis *plus* Core Analysis. It all adds up to an economical coordination of drilling, coring, and core analysis.

"If it's worth coring, it's worth analyzing."

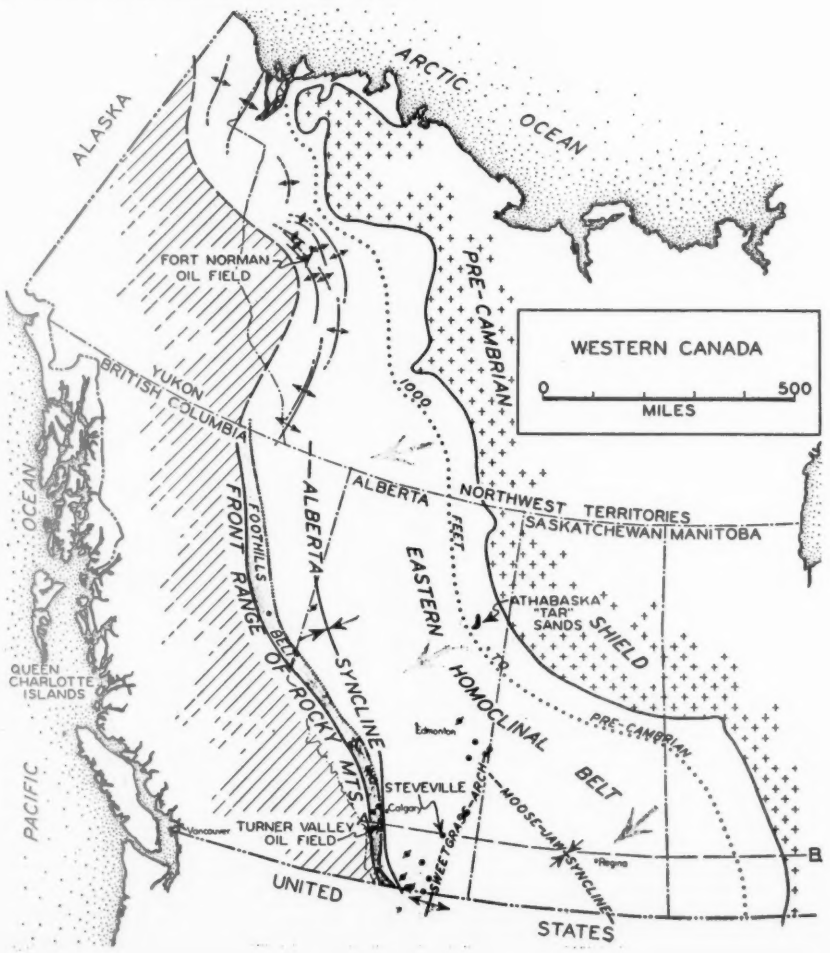
CORE

PETROLEUM RESERVOIR

miles north and south, containing a "guesstimated" oil reserve in excess of 200,000,000 bbl.

The first Leduc well discovered oil on February 13, 1947. Wells here average about 5000 ft in depth and take only a fraction of the time to drill that was required for an average Turner Valley well with depth of from 9000 to 12,000 ft. Even at today's higher wages and sharply higher prices for equipment and supplies, drilling costs represent probably 60 per cent or thereabouts of the outlay for a prewar well at Turner Valley. An added attraction lies in the fact that Leduc oil today brings a price of $3.47 per bbl, compared with prewar prices ranging from $1.00 to $1.25 at the casinghead in Turner Valley. Initial flush flows of 1000 to 1500 bbls per day have been found, but in accordance with provincial conservation regulations wells are choked down through ⅛-in. or ¼-in. deliveries, and usually settle down to a production of between 80 and 120 bbls a day.

Production engineer, Don Wilson, watches depth indicator as he lowers the bomb which will record bottom hole temperature and pressure at Imperial Leduc No. 3. The bomb is lowered on strong steel wire and records are made at every 1000 ft.



Map showing general features of western Canada. Main area described lies between Front Range of Rocky Mountains on west and dotted line marking depth to pre-Cambrian of 1000 ft on east.

(From Bulletin of The American Association of Petroleum Geologists, August, 1941, Page 1448.)

▸ **Early history.** The original discovery well was spudded in November, 1946. Passing through 3400 ft of gas bearing sand, then a little light oil, water was encountered at 4300 ft. At 4390 ft the drill struck the top of the Devonian. For the next 100 ft it penetrated limestone and dolomite rock with shows of heavy oil, some gas, and more water. Underlying this was a thick bed of anhydrite, underlain by 40 ft of red shale. At 4995 ft the bit struck porous dolomite. From here on porosity and oil showings improved and at 5066 ft drilling was stopped and a drillstem test made. Casing was run and cemented to 5029 ft.

The initial flush flow was almost 1000 bbls a day, the largest flush flow ever found up to that time on the Canadian prairie. In March a second well was spudded 1¼ miles south, and a third 2 miles northeast. Both

Baash-Ross News

BAASH-ROSS TOOL COMPANY · LOS ANGELES · HOUSTON · NEW YORK

OUR 28th YEAR

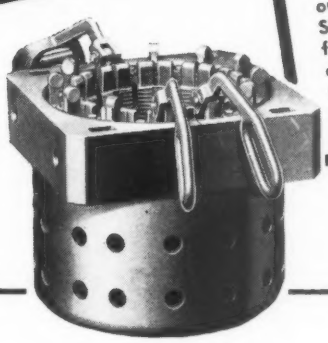
Why not run your casing with the same simplicity, speed and convenience as you do drill pipe?

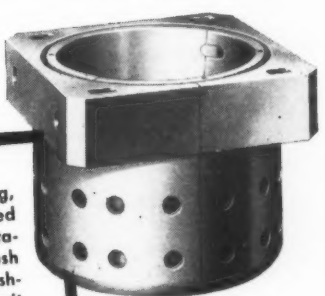
Here's how—with the BAASH-ROSS SPLIT ROTARY TABLE CASING BUSHING

Did you know that you can run casing jobs with the same ease, convenience and simplicity with which you run your drill pipe? All that you need is a Baash-Ross Split Rotary Table Casing Bushing which replaces the regular master bushings in the rotary table and permits casing to be run *through the table* with the crew working at the same convenient height and in the same efficient manner as when handling drill pipe. Here's all you do...

1 Simply lift out the regular master bushings, drop in the Split Casing Bushing and lock the table. The Split Casing Bushing is thus solidly supported and properly centered over the hole so that you can run casing with the same ease and with the crew working at the same convenient height as when running drill pipe.

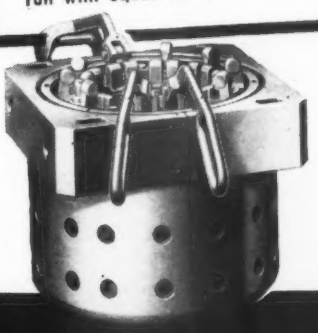
2 For large diameter casing, the larger sizes of Baash-Ross Type "UC" Casing Slips can be seated directly in the bore of the Split Bushing. As outlined below, "UC" Casing Slips insure a uniform full-circumferential grip on the casing that eliminates risk of damaging the thin casing walls through concentration of slip pressure.





3 For smaller sizes of casing, drop in a split and hinged Slip Adapter which is tapered on both sides and sets flush with the top of the Casing Bushing. Removable handles permit quick and convenient insertion of the split and hinged Slip Adapter.

4 With the Slip Adapter in place, Baash-Ross Type "UC" Casing Slips to fit smaller sizes of casing can be set directly into the tapered bore of the Slip Adapter, thus permitting a wide range of casing jobs to be run with equal efficiency.

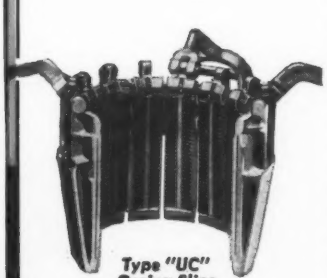


Handles Wide Range of Casing Sizes

Rotary Bore	Maximum Casing Size
27½" Dia.	21½" API
24½" Dia.	18⅝" API
20½" Dia.	16" API
17½" Dia.	13⅜" API

Modern rotary tables are able to support even the longest and heaviest casing strings with ample safety, and the Split Rotary Table Casing Bushing is ruggedly built to withstand the same service. Yet it is light in weight and readily portable in small tool cars.

The maximum casing size handled by the Casing Bushing is determined by the diameter of the opening through the rotary table. The accompanying chart shows the largest casing size that will pass through the Casing Bushings made for various size rotaries.



Type "UC" Casing Slips

Type "UC" Casing Slips Insure Maximum Safety in Modern Casing Operations

Baash-Ross "UC" Casing Slips are the most modern advancement in slips for handling casing strings. Because they consist of many narrow slip segments flexibly linked together, they *u-r-a-p* around the casing for a uniform, full-circumferential grip, thus insuring greater safety and maximum gripping efficiency on the relatively thin walls of casing strings. Their easily-renewable liners provide long life and low maintenance, and they have many other unique features. For more details see page 276 of the 1947 Composite Catalog.

wells found the Devonian horizon, which yielded the discovery, too tight to give up oil. Early in May the No. 2 well entered a new oil and gas bearing zone at 5375 ft. No. 3 well found this deeper zone at 5173 ft. This well was completed at 5313 ft and showed a flush flow exceeding 1000 bbls. No. 4 well reached the lower zone at 5330 ft, stopped at 5360 ft and found a better flush flow than the previous ones.

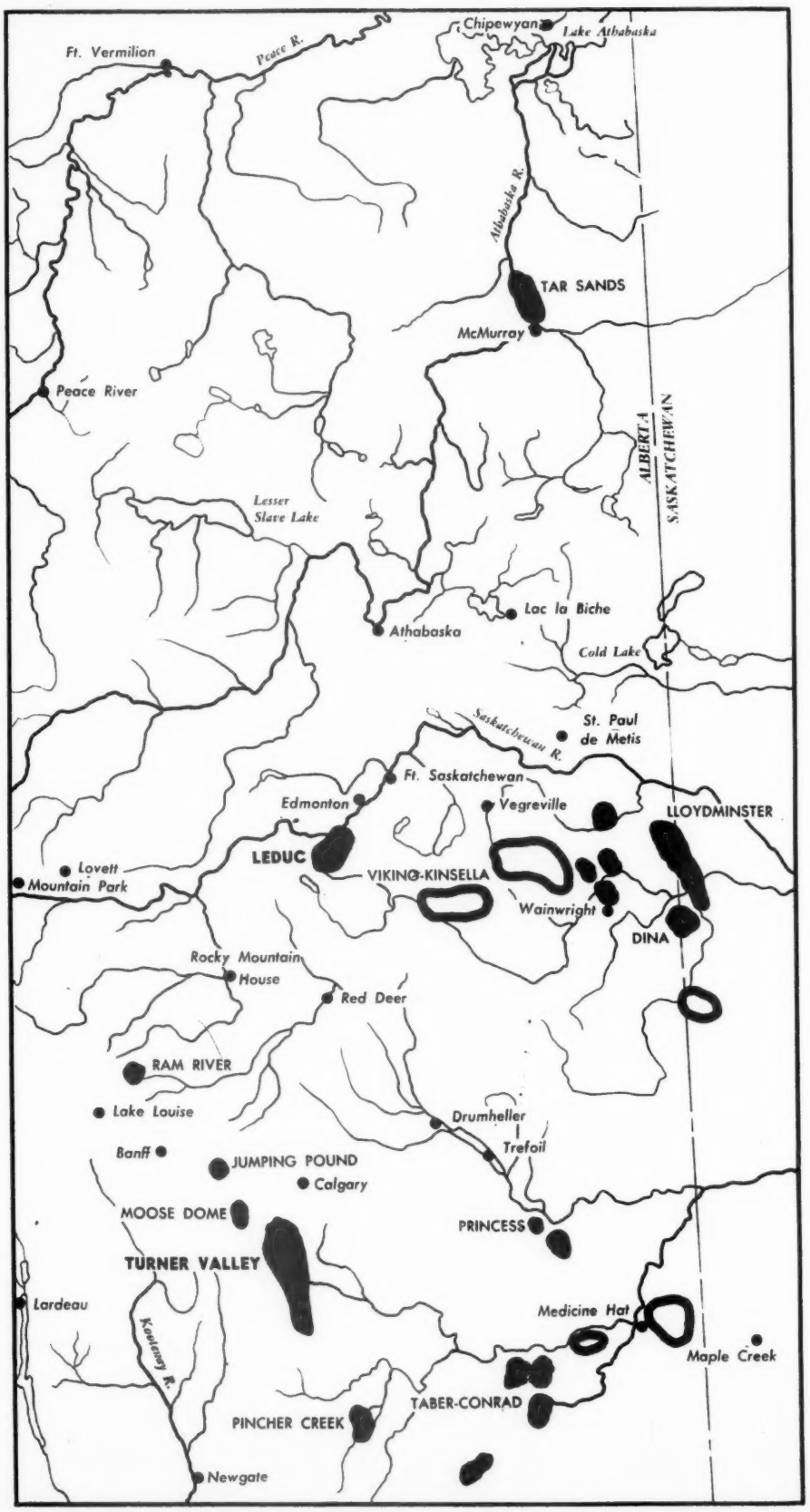
At the end of August, 1947, came the first independent success, Globe Leduc West No. 2, producing the best flow to date of 158 bbls the first hour, from the lower Devonian zone. By the end of November, with 21 successes, 16 of them Imperial wells. there was ample proof that here was a major oil field. Bidding for scattered tracts of oil rights not held by Imperial became very active.

A well goes wild. Last spring one of the independent's wells, Atlantic No. 3, "went wild," causing a temporary shutdown of production in May from the field, on authority of the Conservation Board, for safety reasons. Some 10,000 to 12,000 bbl a day has been wasting from the blowout, though two-thirds of the wasted oil was salvaged, and most of the remainder returned to the reserve through two adjacent wells. All the wells are now back in production, some at increased allowables to make up for lost time.

New refinery at Edmonton. Leduc is principally an Imperial Oil field, and Imperial has great faith in its future. More than a year ago, foreseeing the need for a nearby refinery, they purchased the entire equipment of the then idle Whitehorse refinery in the Yukon for a million dollars from the Foreign Liquidation Commissioner, U.S. Department of State. This much traveled refinery, dismantled and moved from Texas in 1943, was erected at Whitehorse at the time the Japs were threatening Alaska, to refine the oil piped there from Norman wells through the 700-mile Canol pipe line. Designed with a minimum capacity of 3000 bbl a day, it operated 11 months and processed less than a million bbl, but had been idle since March, 1945.

Imperial dismantled this plant and moved its equipment, weighing some 7000 tons, a distance of 900 miles by truck over the Alaska Highway to Dawson Creek, where it was loaded on cars for the rail haul to Edmonton. Much of the trucking had to be done last winter, crossing the ice on certain rivers where the loads exceeded the capacity of the existing bridges. This was an expensive operation, but 18 months was saved in the time of getting the plant set up and operating over the time that would have been required to get delivery of new equipment. A substantial saving to Canada in the outlay of scarce U.S. dollars resulted also from the transaction.

Today the refinery is opened and has begun operations. It is reported



Map showing location of principal western Canadian oil fields.

"THOSE ARE THE 5 REASONS WHY I'M FUSSY ABOUT DRILLING VERTICAL WELLS"

"Yes, I know some of the boys claim I'm *too* fussy—but they usually change their minds when they see how it pays off. First, controlled vertical drilling takes less time and uses fewer bits. Take my last well, for instance. Totco records every 50 or 100 feet told me what I was doing every foot of the way, so I was always drilling with the most efficient weight and speed. Bottomed that hole at 5400 feet in 19 days, used 21 bits, and was never 1° off. Fellow next to me took Totco readings only when he happened to think of it: he took 23 days and 29 bits to reach the same depth. And he had a crooked hole.

"Takes less power to drill a vertical well, too. Easier going in, easier coming out, and you don't wear out your drill pipe so fast, either. Another thing—drill a vertical hole, and you don't have to worry about stuck casing. You'll land the casing right where you want it, and get a better cement job, too. And if you want to hear some bad language, just ask one of the production boys about the trouble he has pumping in a crooked hole.

"But the big thing to me about controlled vertical drilling is the way it cuts down key-seating, washouts, twist-offs and the like. No rig-time lost on fishing jobs, no lost tools. No whipstocking. No backing up and re-drilling. Man, when you think it over, you can't *afford* to drill anything but a vertical well."

"That's why I drill vertical wells . . . I've neither the time nor the money to drill crooked wells!"

Based upon the actual statements of hundreds of drillers and drilling superintendents in all parts of the country, and in many foreign fields.

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A shot of the crude distillation unit at the new Imperial Oil refinery at Edmonton a short time after it went into operation. Scaffolding on the debutanizer was erected for installing insulation outside of the tower.

to have cost close to $9,000,000, has a current daily capacity of 4000 bbl, to be stepped up before year's end with completion of cracking and treating units to 6000 bbl a day. This raises Alberta's refinery capacity by some 35 per cent and total capacity of the three Prairie Provinces by 15 per cent. Oil is gathered into an 8-in. pipe line 8 miles long to the nearest rail outlet at Nisku, where it is loaded into tank cars.

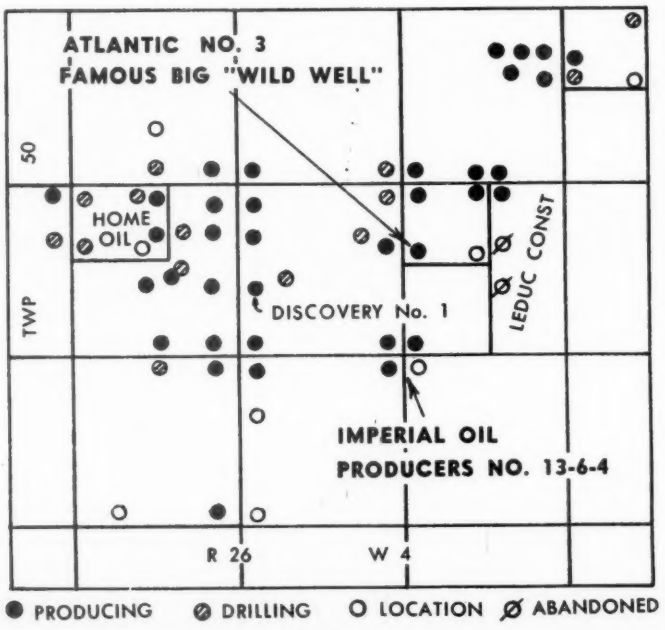
Other production facilities. This pipe line is presently being extended to serve the Edmonton refinery. It will have a capacity of 40,000 bbl a day, three times the present output of the field, and will be a common carrier. This is a measure of Imperial's optimism regarding the ultimate capacity of the field. Already plans are under way to double the refinery's capacity, and H. H. Hewetson, president of Imperial, forecast last year that his company would supplement the present refinery by the erection of a $4,000,000 lubricating oil plant in Edmonton within the next three years.

All Leduc's oil will not be marketed in Edmonton, however. Calgary refineries have excess capacity now that Turner Valley output is depleted. There is considerable refining done at Moose Jaw, Regina, Brandon, and Winnipeg, as well as a number of smaller centers in the three Prairie Provinces. Imperial is already working on a plan to build a 500-mile 10-in. oil pipe line from Leduc to Regina, with a capacity of 90,000 bbl a day, at a cost of some $35,000,000, whenever assurance is given that the 80,000 tons of scarce steel for pipe can be made available.

To justify such a pipe line, however, discovery of other fields besides Leduc would be necessary. Already another major field appears to have been discovered at Redwater, 30 miles north east of Edmonton, giving promise of a higher output per well than for those of Leduc. These wells are shallower than those at Leduc and the oil zone is thicker. This is another Imperial discovery.

The new townsite at Leduc, situated on the banks of the Saskatchewan River, has been named Devon, a name derived from the Devonian limestone strata in which the oil is found. Work was begun last fall on erection of prefabricated dwellings at the site, and rapid progress is being made on the provision of 300 of them, as well as a hotel, school, bus depot, postoffice, and a community hall, all equipped with running water and electricity and heated with natural gas from a nearby gas well.

New Crown lease regulations. The Alberta Government early in April issued new regulations pertaining to oil and gas rights owned by the Crown in the province. The new Crown Lease Agreement stipulates a maximum royalty on oil that may be collected by the government during



Productive section of Leduc field in August.

another first in engineering skill and high quality . . . the new

BJ POWAIRMATIC tubing tong

MOST POWERFUL. A 5.3 hp vane-type air motor drives the new BJ Powairmatic Tubing Tong through a two-speed transmission and chain drive. The motor, largest of its type available, and the efficient drive assembly make the Powairmatic Tubing Tong the most efficient and powerful power tong on the market.

HIGHER UNIFORM TORQUE. There's no guessing with the Powairmatic. The motor drives the tool at 16 rpm in low gear . . . develops over 3980 ft lbs of torque at 90 psi for positive "make-up" or "break-out."

FASTER "SPINNING-UP". Wells get back in production much faster with the Powairmatic. Time is saved. Money is saved. The element of fatigue is reduced. "Spinning-up" in high gear at 60 rpm with 1062 ft lbs of torque, the new BJ Powairmatic Tubing Tong saves up to 20 minutes per round-trip on short strings!

INTERCHANGEABLE JAWS. Separate jaws and bushings are provided for tubing or drill pipe from 2" through 3½" O. D. Simple removal of one pin permits exchange of jaws and bushings. Full-length dies eliminate wobble and insure uniform grip without slipping or crimping. Write for complete information on the new BJ Powairmatic Tubing Tong—available now.

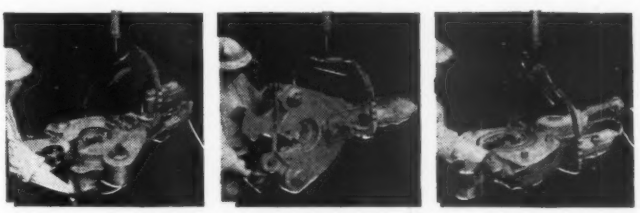
BJ MEANS ENGINEERED OIL TOOLS

parts. Easy reversal of the Powairmatic adds convenience to testing for collar or tubing leaks.

Can be used as a light rotary table. For drilling ratholes. Clean-out work. Inside cutting. For any light job . . . the design of the API chain drive and proper positioning of the high-quality bearings and sprockets maintain constant rotating speed.

OIL BATH LUBRICATION. Transmission and drive are enclosed in an oil bath, assuring proper lubrication for high-speed rotating parts. Standard alemite fittings for all other lubrication points.

INTERCHANGEABLE JAWS. Separate jaws and bushings are provided for tubing or drill pipe from 1¼" through 3½" O. D. Simple removal of one pin permits exchange of jaws and bushings. Full-length dies eliminate wobble and insure uniform grip without slipping or crimping. Write for complete information on the new BJ Powairmatic Tubing Tong—available now.



To reverse the tong, just roll it over.

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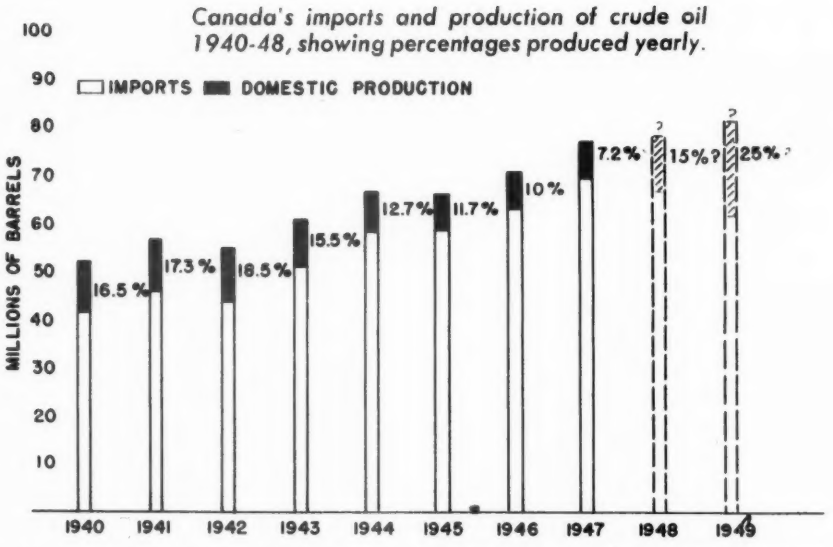
the life of the lease (21 years, and renewable so long as oil is produced). The maximum Crown royalty is one-sixth of gross production. Until now, royalty has not been set in the lease, but has been fixed from time to time by order-in-council. A government could raise the royalty to a prohibitive rate if it so desired. The present royalty, which will continue in effect until 1951, is a choice between 12½ per cent and a sliding scale ranging from 5 per cent to 15 per cent. The new lease sets the limit after 1951 at 16⅔ per cent.

Major United States oil companies are showing considerable interest in Alberta fields, but some concern is felt over certain features of the province's new oil and gas policy, as witnessed by recent experience in changed reservation and lease regulations and in the disposal of Crown reserves.

The Honorable N. E. Tanner, Minister of Lands and Mines for Alberta, speaking to oilmen at Tulsa last May, gave assurance however that further legislative changes, if any, would not be retroactive. He stated also that, "the Province of Alberta is diametrically opposed to government financed exploration and development. We can get the most active development where individual and competitive enterprise is carried on."

The "hottest" area of discoveries at the moment in the entire Leduc area is a Crown Reservation adjoining Leduc, known as Woodbend. Here the Crown has been experimenting with various types of offerings on a small scale, has already disposed of most of the 13,000 acres available. Rights on quarter sections here were bid for $189, $313, and in one case more than $500 an acre, cash bonus, with no royalties payable to the Crown.

Canada's imports and production of crude oil 1940-48, showing percentages produced yearly.

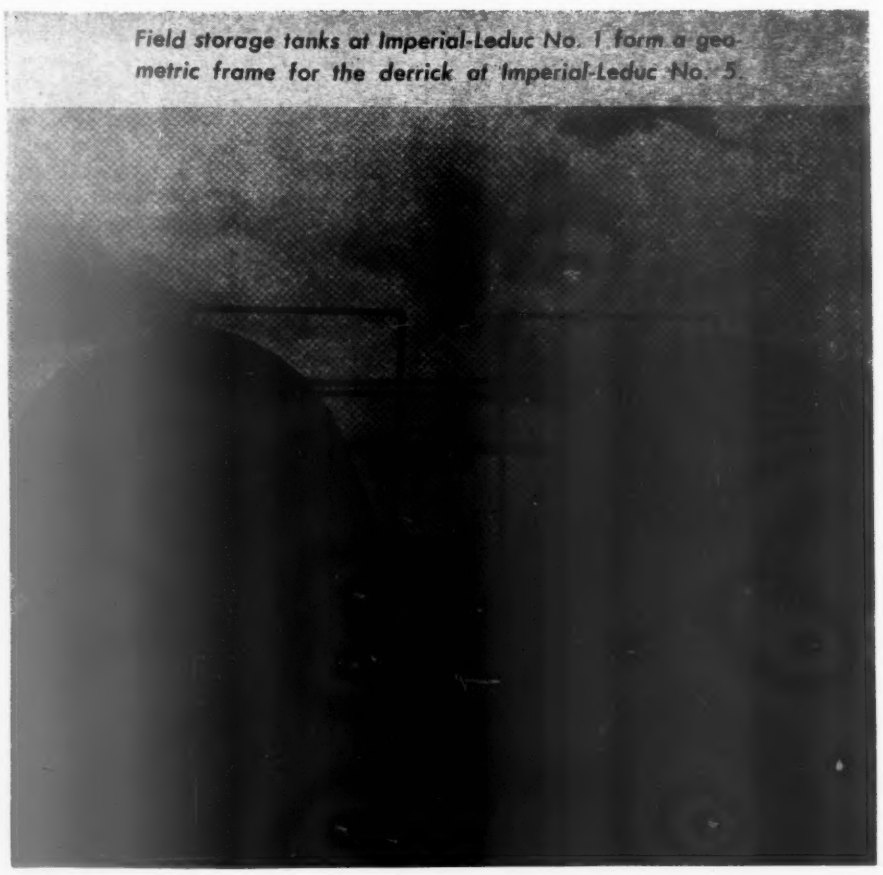


Crude oil production and imports in thousands of barrels.

Year	Produced	Imported	Total
1940	8,372	42,687	51,059
1941	9,710	46,578	56,288
1942	9,931	44,076	54,006
1943	9,317	50,908	60,225
1944	8,440	57,927	66,367
1945	7,696	57,995	65,692
1946	6,990	63,343	70,335
1947	6,892	69,828	76,721
1948 (forecast)	12,000	68,000	80,000
1949 (forecast)	20,000?	62,000?	82,000?

▸ **Toward self sufficiency.** Canada used 96,000,000 bbl of oil last year. Only a little more than 7 per cent was produced in the Dominion, 57 per cent was imported from the United States. Thus Canada is in a very vulnerable position in the event of shortages in the U. S. causing curtailment of imports. Besides this, Canada's current shortage of American dollar exchange makes it imperative that domestic production be speeded up. Cooperating to this end, Imperial Oil last spring announced it was disposing of its foreign holdings of International Petroleum in South America for $80,000,000. thus effecting a two-way saving in adding to Canada's supply of U. S. funds and in procuring working capital for further oil exploration and development in Canada.

Field storage tanks at Imperial-Leduc No. 1 form a geometric frame for the derrick at Imperial-Leduc No. 5.



Leduc will be the first fruits of this policy. Dr. G. S. Hume, Chief of the Geological Survey, Department of Mines and Resources of Canada, and one of the foremost Canadian oil authorities, speaking recently at Banff, Alberta, to Canadian engineers, expressed the belief than Leduc's output may ultimately attain a peak production roughly twice Turner Valley's 1942 peak production of 29,000 bbl a day. Even at present progress, this could not be accomplished before another two years, perhaps longer, by which time Canadian oil consumption may have further increased. Yet if these hopes are realized, it is well within the realm of possibility that Canada could be then producing somewhere between a third and a half of her oil needs. This is without counting on possible major discoveries in any of the numerous promising areas now under exploration. ★ ★ ★

Plastic Tubes Preserve Core Information

By WALLACE SAWDON[1]

EXCLUSIVE

CORES of subsurface formations provide valuable data that are well worth the time and expense that their recovery entails. These cores are physical records; but they are records that present a problem in handling, storage, and preservation. Metal trays have been widely used for examination at the well while cans or glass containers have had to be depended upon for shipping, storing, and preserving the cores. None of these are even convenient for immediate use and are far from satisfactory for shipping purposes or future reference. It was for these and other reasons that plastic tubes* were developed.

These tubes are made of transparent plastic that is unaffected by oil, gas, water or other fluids that are usually encountered in subsurface formations. In order to accommodate cores of all sizes they are made in diam of from 1 to 3 in. (in increments of ¼ in.) and are supplied in any length specified. To handle side-wall cores a special tube 1⅜ in. in diam by 7 in. in length is furnished.

All of the tubes are closed at each end by specially fabricated plastic caps, one of which is applied at the factory by a solvent compounded for this service. The second cap is made to fit snugly on the tube and is applied by the operator who seals it with the same type solvent, which is supplied in bottles with a brush applicator. As shown in Fig. 1, when properly sealed the tube becomes an air-tight container that is impervious to water, gas, or oil, and it must be cut in order to get at the contents.

Because of the transparency of the plastic core tube, the identification of the core is itself sealed within the container and cannot be lost or separated from the core. All data relative to the core are written on a tag or label that is inserted before sealing in such a way that it can always be read from the outside. Since the tube is sealed at each end the label cannot be removed, altered, or defaced without cutting the tube. This assures the geologist that the correct information is available for his use as long as the tube is uncut. Samples may be tagged and sealed as they are removed from the core barrel by a driller or tool pusher, an operation that requires no training or experience. See Figs. 2 and 3.

The tube being clearly transparent, the stratum and texture of the core may be examined at any time without opening the tube. By using these tubes immediately to store core samples it is not as necessary for the geologist to be on hand at the well when the core is pulled. He will thus be able to "cover" more wells with an assurance of correct core recordings. By the use of the plastic tubes, the tray system can be abandoned, and there will be less need for core racks with the constant danger of mixing or reversing samples. As the cores are sealed at once they are not subject to weathering, contamination, tampering, or loss of volatile or friable content.

A small piece of the core can be removed for analysis by slitting the tube opposite the section to be sampled. This slit can then be repaired with the solvent and a small piece of tubing, the whole procedure being much simpler than recanning a core.

If it is necessary to remove a large sample of the core from the tube, a record may be kept of the removed section by replacing it with a piece of tube of next smaller size cut to proper length. A label with identification as to disposition, date, etc., is then inserted, the tube recapped and the core filed away in the same length tube. This is illustrated in Fig. 4.

Because the capped tube is gastight, a gas analysis can be made since the sample reaches the laboratory in the same condition as if it were canned.

▸ **Facilitates Shipping.** The plastic tubes are very light, being but a fraction of the weight of steel and less than that of glass. The material of which they are made is strong and the container formed will not break like glass; moreover, the possibility of loss due to the falling out of a cork is eliminated. As the core is sealed in at the well the danger of possible tampering is lessened.

No canning equipment is, of course, needed and the cost of such equipment and the labor involved is saved. For example, a 3-ft core inserted in the plastic tube requires but one simple sealing operation. Moreover, rust cannot form on the plastic to contaminate the sample as is possible when it is canned. To can the same sample would require six or more cans, involving the

[1]Technical Information Service, Los Angeles, California.
*Extrulite Core Tubes.

FIG. 1. The plastic core tubes are made in any lengths that may be specified and in diameters from 1 in. to 3 in. in increments of ¼ in.

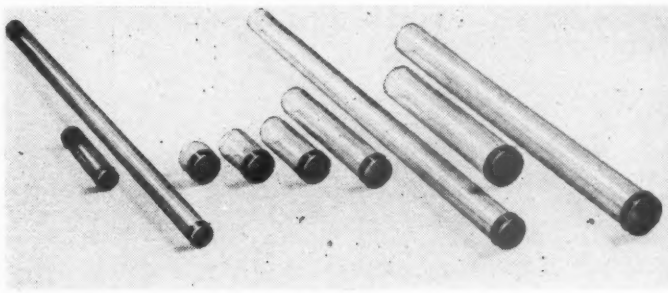


FIG. 2. Core is shown here being pushed directly from core barrel into the plastic tube. Core may first be placed in tray and thence into the tube.

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FIG. 3. A specially compounded solvent is applied to the cap and tube to provide a fluid-tight seal. The cap may be attached with scotch tape if it is to be removed before final sealing. Note the inserted label.

use of bulky canning equipment and a minimum of six sealings.

When the contents are mailable, the tube may be mailed (or expressed) without outside wrappings The light weight of the container plus the time and material necessary to prepare for shipment offers quite a saving, especially if the sample is to be sent by air. For transporting "no dope" cores, tubes made of opaque plastic are available. As an alternative, the cores may be wrapped in tinfoil or paper before insertion into a transparent tube.

To facilitate the handling of cores and tubes at the well, an aluminum stand is available. This device will support nine 3-ft tubes in a vertical position while they are being filled. Also available is a carrying case that holds 25 tubes of the 2-in. and 2½-in. size, the tubes being either full or empty. Extra caps and solvents can be obtained and a complete core service may easily be set up by the operator. The plastic tube system is especially advantageous in overseas operation and on wells that are to be cored in great detail.

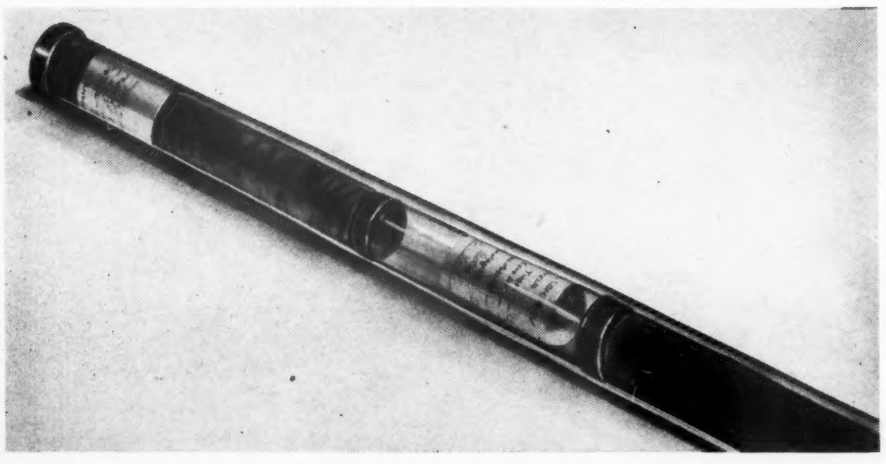
Geologists who take samples of bit cuttings from the mud screen at regular time intervals to correlate with the drilling record will find this system of great value. Spacers to mark the time the sample was taken are used so that the samples can be identified by correlation as to depth at which they were taken, thus providing a most interesting series for the paleontologist.

▸ **Other Uses for Plastic Tubes.** There are, of course, many other uses for the durable plastic tubes here described and particular applications are naturally made. Engineers, for example, are using them to file drawings and prints that must be protected against the ravages of time and insects. The container is air-tight and dry and eliminates the formation of mould.

Oil tool manufacturers who ship small parts that must reach the user free from rust and scratching and with assurance that tags or directions will not be lost have found the plastic tubes of particular value. Several firms are packaging swab rubbers that must be free from deteriorating influence and highly-machined parts that must be protected from rust, particularly in shipments to tropical countries.

One recent use of the tubes is for the transportation of water samples taken at the well that must be shipped to the laboratory for analysis. ★ ★ ★

FIG. 4. If a sample is taken from the core for analysis, its disposition, date, time of removal and other data are recorded and the record placed inside a section of tube of next smaller size. This tube is cut to the correct length and inserted to take the place of the removed sample.



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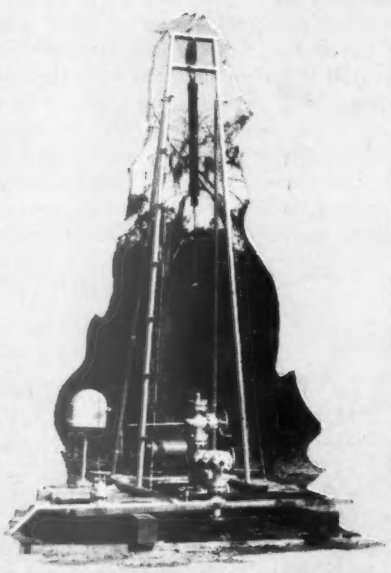

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How to Select Sucker Rod Pumps

By KENNETH N. MILLS*

EXCLUSIVE

As the sucker rod pump is the major factor determining the well load and is one of the common causes for well servicing, the selection of the proper size and type pump is one of the key factors determining the operating cost of a pumping installation. Comparing the initial cost of the most expensive type pump to the cost of a few well servicing jobs, it is apparent that, if the pump reduces the frequency of well servicing, the savings would more than pay the initial cost of the pump. Outside of variations in materials, sucker rod pumps are available in several types and the design of each type can be made to suit specific conditions. Each type pump has certain basic characteristics that enable it to cope more adequately with any well conditions. The pump selected should be one that will resist the most severe condition existing in the well. To combat severe corrosive conditions, some types of pumps are available in stainless grade steel.

The optimum pump bore size for a given well is dependent on the amount of fluid to be lifted in a certain period of time. The API standard pump sizes are shown in Table I. This table also shows the gross plunger areas for each pump and the per cent increase or decrease in plunger area from 1¼ in. As the magnitude of the fluid load is approximately proportional to the gross plunger area, this portion of the table shows the relative effects of the various plungers on the well load.

Table 1.

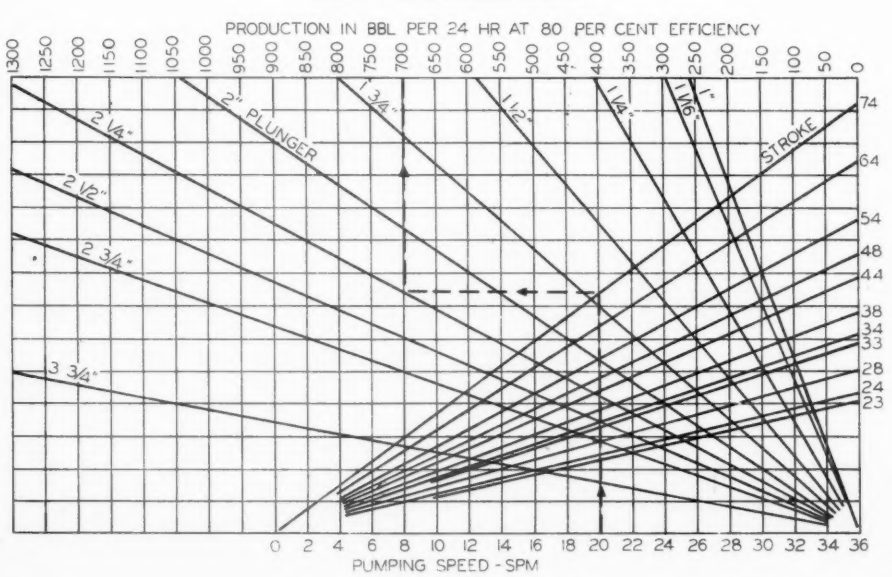
Pump bore	Plunger area, sq in.	Per cent of area of 1¼-in. plunger
1	.785	64
1 1/16	.887	71.5
1¼	1.227	0
1½	1.767	144
1¾	2.405	196
2	3.142	256
2¼	3.976	324
2½	4.909	400
2¾	5.939	483
3¾	11.045	900
4¾	17.721	1448

This table illustrates the importance of using the smallest practical pump, because as the pump bore increases, the magnitude of the well load is increased and larger sucker rods and surface pumping machinery will be required. The most economical pump bore size is one that will obtain the desired production in the most economical period of time. If production labor is available over a 24-hr period, this time period should be about 20 hr. The surface stroke length should be the maximum available on the pumping unit, and the pumping speed should be relatively slow. These operating conditions will allow a margin of safety in the form of increased pumping speed to correct errors in estimates of desired production. The production neglecting rod stretch and overtravel can be obtained from the chart shown in Fig. I. This chart is based on 80 per cent pump efficiency to compensate for the effect of gas and fluid slippage past the plunger.

Sucker rod pumps fall into two general classifications. The older of the two types is the tubing pump, the barrel of which is attached directly to the bottom of the tubing string. In this pump the plunger and traveling valve are attached directly to the lower end of the rod string and are lowered into the well on the rod string. The standing valve assembly can be fitted with a number of devices that can be used to pull it out of the well with the rod string. A typical tubing pump with a cup type plunger less the standing valve pulling device is shown in Fig. 2. This type can be fitted with a metal plunger, which has the advantage of lower friction losses. When it is fitted with a metal plunger, the pump should have an extension nipple as shown in Fig. 3. With the extension nipple, the plunger can stroke out both ends of the barrel. This will tend to distribute the wear evenly over the length of the barrel and permit the installation of an oversized plunger to reduce slippage without refinishing the barrel. Also, it will prevent the formation of gyp in the unused section of the barrel, which might interfere with pulling the plunger or increasing the stroke length.

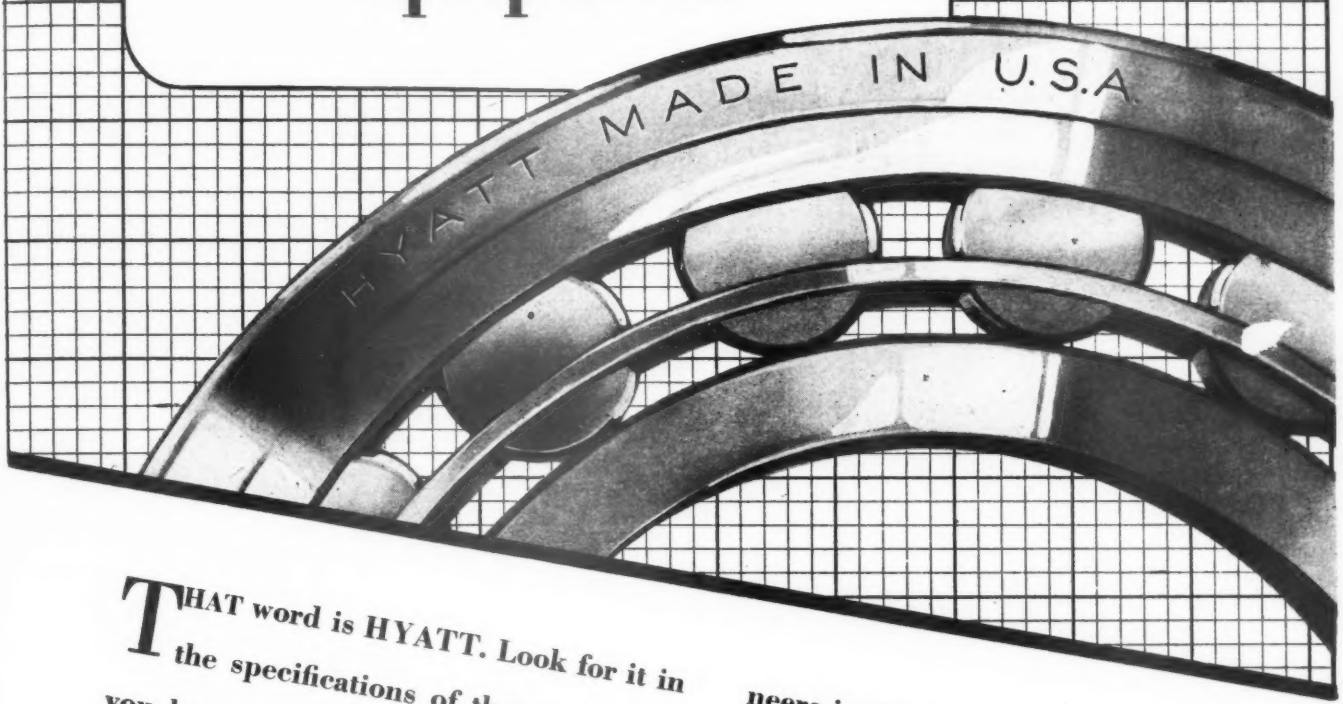
The rod type pump was developed to reduce the cost of well servicing to repair the pump. In this design, the entire pump assembly, consisting of the plunger, barrel, standing and traveling valves, are lowered into and removed from the well on the lower end of the rod string. The pump assembly rests in and seals off on a seating shoe or nipple or an existing tubing pump barrel. This type pump has the obvious advantage that it can be removed by pulling the rods only and it is not necessary to pull the tubing to remove the pump barrel. As it is necessary to remove all the pump parts to service the pump, the possibility of leaving a damaged part in the pump, which would necessitate a second repair job, is reduced to a minimum. Also, as the pump is run into the well as an assembly, its plunger and standing valve assembly is not subject to damage from the

FIG. 1. Production chart.



*Assistant Chief Mechanical Engineer, Emsco Derrick and Equipment Company, Houston, Texas.

A word for the buyer of pumping equipment



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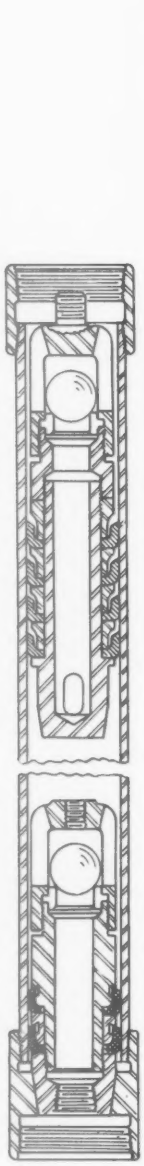

FIG. 2

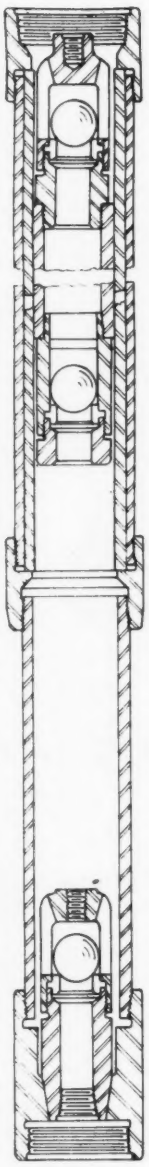

FIG. 3

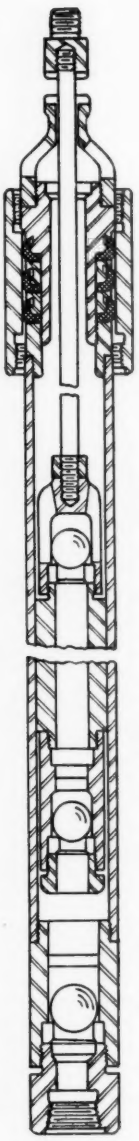

FIG. 4

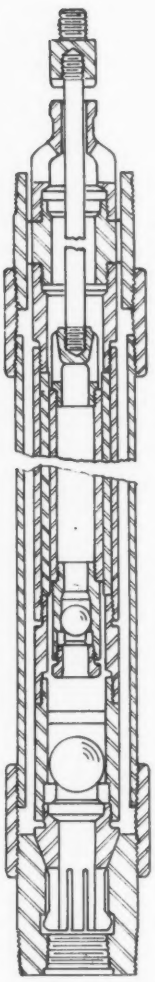

FIG. 5

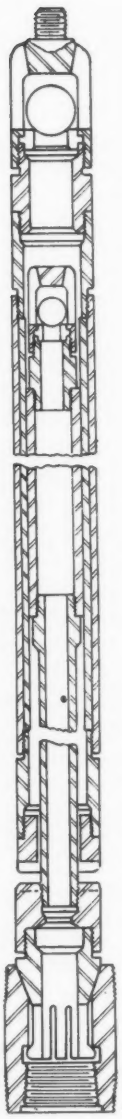

FIG. 6

walls of the tubing. However, as the entire rod type pump assembly must pass through the tubing, its maximum bore for a given tubing size is less than that of the tubing type pump.

In general, rod type pumps are available in three basic constructions, which are: stationary barrel with top hold down; stationary barrel with bottom hold down; and traveling barrel. A typical stationary full barrel pump with top cup hold down is shown in Fig. 4. The plunger is shown with two traveling valves. These pumps are available with any practical number of traveling valves, either full or liner barrel construction and mechanical or cup type hold down. A typical stationary liner barrel pump with bottom mechanical hold down is shown in Fig. 5. A traveling liner barrel type pump with a mechanical hold down is shown in Fig. 6. As will be explained, each type of pump has certain advantages over the others when producing specific types of oil well fluids.

The top hold down type pump has some advantages when producing gassy or sandy fluids. As the point of seal off between the tubing and the pump is just below the point, oil is discharged from the pump, sand cannot settle between the pump and the tubing and stick the pump in the tubing. Also, if the tubing perforations are just below the seating shoe, the effectiveness of the gas anchor can be increased, because its effective length will be inoreased by the length of the pump. As the outside of the pump barrel is in a fluid under relatively low pressure when compared with the fluid inside the barrel, there is a tendency for the clearance in this type pump to increase due to this differential pressure. This will cause a slight loss in efficiency when producing deep wells.

The bottom hold down pump is well suited for use in deep wells producing a sand free fluid. As its seal is at the bottom of the pump, it can be seated in an existing tubing pump barrel. Due to the location of the sealing device between the pump and the tubing, the barrel is either in equalized pressure or under a pressure condition that tends to reduce the clearance between the barrel and the plunger. This condition tends to keep plunger slippage losses at a minimum. This type pump should not be used in wells producing sand, because the sand will settle in the space between the pump body and the tubing. If this sand becomes tightly packed it will stick the pump in the tubing and may necessitate a stripping job or cause the rods to be overstressed in the pulling of the pump.

The traveling barrel type pump is well suited for use in wells producing a sandy fluid that are pumped intermittently. In this pump design, the traveling valve also serves the purpose of a sand check valve, and prevents sand from settling on top of the plunger when the well is shut down. While sand may settle between the pump and the tubing, the pumping action of the barrel will displace this sand after a few strokes. As in the case of the bottom hold down pump, the pressure differentials across the barrel are favorable to the maintenance of small plunger clearances and high efficiency.

Rod type pumps are supplied with either cup or mechanical hold downs. As the area of the hold down is greater than the plunger area, the force required to unseat the pump will be greater than the force required to lift the plunger. In deep wells, this increased force may be sufficiently great to overstress the sucker rods. The minimum forces required to unseat the various sizes of API seating devices are shown in Fig. 7. The valves shown in this chart do not include allowances for friction. In the mechanical hold down, the additional force required to release the hold down is small. In the cup type hold down this force will be larger than that required to release the mechanical hold down. However, the exact amount of the force cannot be predicted, because it will depend on whether the cups become stuck in the seating shoe. For this reason the mechanical hold down is preferable, if the rod stresses due to unseating are high. The rod stress due to unseating the pump should be kept well below the yield point of the sucker rod mate-

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rial to prevent permanently stretching the rods when unseating the pump.

Each basic type of pump is available in either full barrel or liner barrel construction. In the full barrel construction the pump barrel is a single piece of seamless steel tubing, and in the liner barrel construction, the barrel usually consists of a series of .12 in. long liners. Due to the short length of the sectional liners used in the liner barrel construction, the bores can be held to greater accuracy in manufacture. Also, as the liners are not subjected to tensile loads, they can be made of hard abrasion resistant material to obtain greater life.

These pumps are available with either cup, ring, or metal plungers. The cup and ring type plungers have the advantage of low first cost. However, they have the disadvantage of increasing the well load due to high friction losses. The exact value of these friction losses is a function of the plunger load, cup stiffness or fit of rings in plunger and number of cups or rings. The three dynamometer cards shown in Fig. 8 illustrate the effect of plunger friction on well load. In this series of tests, a ring type plunger was used, and the number of rings was reduced by one-half for each test. In each case the total production remained unchanged. In the case of cup type plungers, cup stiffness can have a similar effect on the rod load, as the fluid load expands the cups against the wall of the barrel, and, if the cups are extremely soft, excessive friction will result. These actions all add to the rod load, and the load on the surface machinery. They have been responsible for premature sucker rod failures and are a definite cause for power loss that will be in excess of that experienced with metal plungers.

Metal plungers are available with either plain or annular grooved surfaces. The relative advantages of the two types of plungers are questionable. One of the theories regarding the grooved plunger is that the turbulence developed in the fluid slipping by the plunger at the grooves decreases the rate of slippage. Also, the grooves act as reservoirs for lubricant and facilitate the lubrication of the tightly fitting plunger. The grooves will tend to trap sand or metal particles passing through the clearance space between the plunger and the barrel. Through this action, they will aid in preventing these particles from cutting the full length of the plunger as the particle passes through the clearance space. If the plunger strokes out of the barrel and exposes a groove, it may trap sand and pull it into the pump barrel.

Another optional feature on a pump is the number of standing and traveling valves. There is an increasing trend toward using two or more valves in series in each location in deep wells. When two balls and seats are used in these positions, the load will not be distributed between the two valves, but it does decrease the possibility of the valves cutting out. If it is assumed that balls and seats fail due to their being held open by the entrapment of a grain of sand on the seating surface and are cut out by fluid passing through the valve at a very high velocity, multiple valves should increase ball and seat life. With multiple valves the possibility of all valves being held open at the same instant is greatly decreased. In the standing valve location, multiple valves have the disadvantage of increasing the resistance to flow on the suction side of the pumping system. In the case of low fluid level wells this may cause a slight loss in pump efficiency and can cause gas or fluid pounds.

When designing a pump installation, it must be remembered that most oil well fluids contain a relatively large amount of entrapped gas that will be liberated when the hydrostatic pressure on the fluid is reduced. The amount of free gas passing through the pump can be reduced by providing the pump with an efficient gas anchor. As the pressure loss on the suction side of the pump reduces the effective pump submergence and tends to cause gases to be liberated from the fluid, the largest possible size pipe should be used in the gas anchor. To assure maximum effectiveness in the gas anchor, the gas bleeder holes in the tubing should be located near the top of the gas anchor, preferably just under the seating shoe.

As gas is highly compressible, and the maximum pressure resulting from compressing a gas is a function of the initial and final volume, the compression ratio of the pump is important. As the maximum displacement of the pump is fixed by the pump bore and the surface stroke, the only factor governing the pump compression ratio is the clearance between the traveling and standing valves. Reducing this distance will increase the pump compression ratio and aid in producing gassy fluids. This can be accomplished by using a closed cage standing valve on the lower end of the plunger in a stationary barrel pump or a valve above the plunger in a traveling barrel pump. To obtain the maximum compression ratio, the pump plunger should be spaced so the traveling and standing valves will just clear when the well is being pumped at the desired rate of speed. ★ ★ ★

FIG. 7

Mechanical hold down is API bottom lock hold down.
Cup hold down is API cup seating and seating unit.

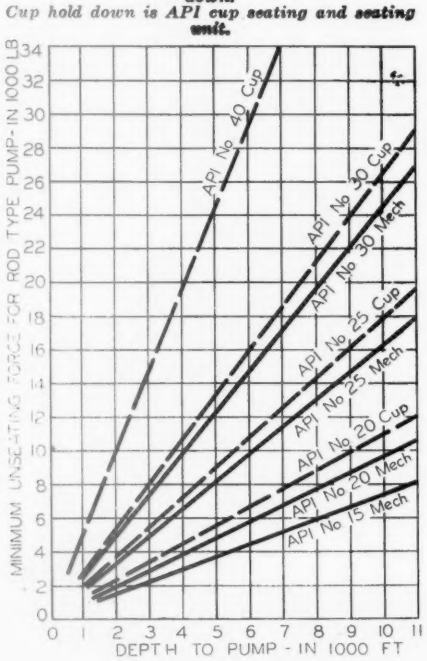
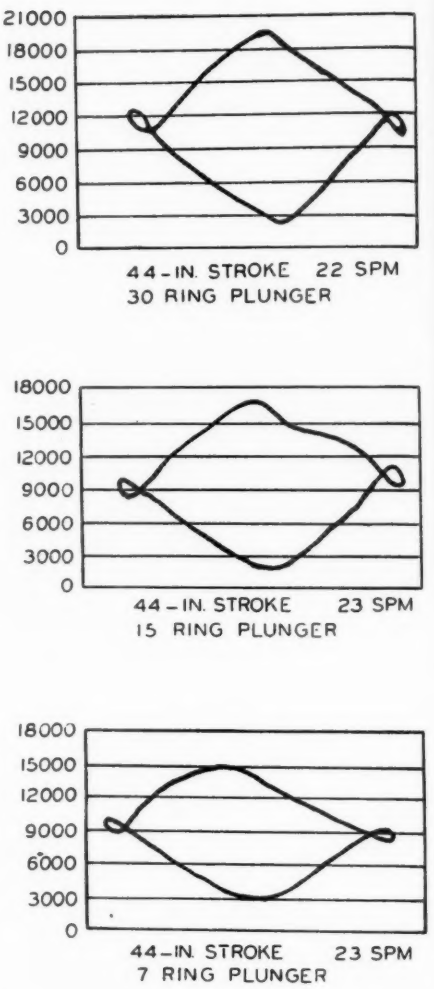

MINIMUM UNSEATING FORCE FOR ROD TYPE PUMP - IN 1000 LB
DEPTH TO PUMP - IN 1000 FT
API No 40 Cup
API No 30 Cup
API No 30 Mech
API No 25 Cup
API No 25 Mech
API No 20 Cup
API No 20 Mech
API No 15 Mech

FIG. 8



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Above—A Spartan Tester about to go into operation. Below—Various sizes of finished packer elements assembled at the Murray plant for delivery to Spartan.

THE NATURAL GAS INDUSTRY*

By E. DeGOLYER

THE natural gas industry is sound. It is mature, well seasoned from an investment standpoint and may be expected to maintain and, I personally think, to improve its relative rank among the major industries of the nation. However, continued growth of the industry depends not only upon the success with which it meets the usual hazards of business, but also upon the manner in which it combats the power and skills of its most virulent enemies, the coal and certain railroad interests, not to mention the crackpot "do-gooders," who often become involved in controversies of which they know far too little.

Historically the industry has had a somewhat erratic growth. The first real impetus came with the completion of several long distance transmission lines from the Panhandle field of Texas and the Hugoton field of Texas, Oklahoma and Kansas to markets in the Middle West. During the four years of 1928-1932 such construction included several long lines that eventually served markets, to mention a few of the larger cities, in Denver, Kansas City, Detroit, Indianapolis, Chicago, and the twin cities, Minneapolis and St. Paul. Because of the heavy investment requirements for trunk lines the depression of the thirties curbed expansion. Since that time a few additional lines have been built and some additional facilities have been added to the older lines.

However, during the intervening periods between the starts and stops in expansion, two other things of tremendous importance were happening. Two things occurred which figuratively have built up a head of steam for substantial and rapid future growth, assuming Stalin does not upset the apple cart! I refer to (a) the amazing increases in proved gas reserves during the past twenty years and (b) the truly phenomenal recognition of and demand for this highly desirable fuel.

My firm as of the first of this year completed a survey of the petroleum reserves, including both oil and gas, of the United States. We estimated the crude oil reserves were 24 billion barrels and the natural gas reserves were in excess of 170 trillion cubic feet.

If the reserves of oil and gas that we consider proved were divided by the approximate productions of 1947, the ratios obtained would be 13 for oil and 29.5 for gas. To say the least the ratio for gas indicates a satisfactory position if compared with the ratio for oil. These ratios should be considered as just what I have called them — ratios. If they are construed or used for anything more than yardsticks or handrails to judgment, serious errors can result and, if carried through in one's thinking, can lead to erroneous conclusions.

With regard to conclusions reached through erroneous thinking based on insufficient facts, I refer you to a paper published by a certain U. S. Government agency in 1919 entitled: "Natural Gas Production and Consumption in the United States." In the general summary of this paper one finds the following statement, and I quote: "The production of natural gas gradually increased from 1906 to 1917 but declined in 1918 so that the peak may have been reached in 1917 and the supply now may be approaching exhaustion;" end quote. Such errors, based on an insufficiency of data, are common. In order to keep from making them when considering the petroleum industry and particularly the natural gas phase, one must remember the facts.

We know that large amounts of money have been and will continue to be spent for petroleum exploration and development. Large additional reserves are sure—and I mean *sure*—to be proved by continued exploration and exploitation. To illustrate partially what I mean when I say additional reserves will be proved, let us look at the record of gas discovery and development as indicated by the various natural gas reserve estimates made since 1918, the year in which the aforementioned paper was written.

In 1919 Mr. Shaw estimated that the nation had a gas reserve of 15 trillion cu ft. In 1931 Mr. Earl Hinds estimated it had 46 trillion. In 1938 Mr. Ralph Davis estimated 62 trillion and in 1942 he estimated it had 85 trillion cu ft. In 1944 the staff of the Petroleum Administration for War estimated the reserves to be 110 trillion cu ft and in 1945 this same agency estimated the reserves at 133.5 trillion cu ft. In 1945 my firm estimated the reserves to be some 138 trillion cu ft; in 1946, approximately 144 trillion and in 1948, as stated previously, we estimated the proved reserves to be in excess of 170 trillion cu ft. The Reserve Committee of the American Gas Association made an estimate in 1946 which totalled some 147 trillion cu ft. This same group in 1948 estimated the reserves to be approximately 165 trillion cu ft. The foregoing estimates represent the remaining reserves as of the first of the respective years. Such rapid increases as indicated are hard to visualize but when it is also remembered that these figures represent net reserves—that is, gas remaining over and above the increased annual withdrawals, total gas production during the period—it is an impressive record.

For the year 1947 production totalled some 5¾ trillion cu ft and yet during 1947, as for more than twenty-five previous years, the net addition to proved reserves has far exceeded production.

My judgment is that the present proved reserves of natural gas and the results of exploration and exploitation have been and are more than satisfactory enough to allow the reserves to be freely produced under good conservation practices.

Several things have contributed to the notable increase in natural gas reserves but the most important has been the tremendous amount of wildcatting that has gone on in the search for oil. Unquestionably, until the most recent years the great majority of gas pools were found as an incident to this search for oil. The gas pools found were more often than not capped and many remain even today as an available but as yet unconnected source of supply. Also the trend to deeper drilling for oil has probably accounted for some of the increase in gas reserves because with depth hydrocarbons seem increasingly to occur in gaseous phase. Inasmuch as constantly deeper drilling for oil will be the trend in the future it seems likely that the possibility of finding additional gas reserves

*An address presented to the Corporate Forum meeting of the National Securities Traders Association at their national convention in Dallas, November 16, 1948.

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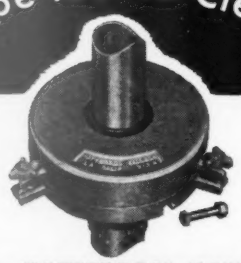

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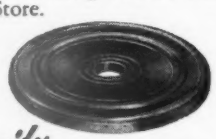

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in the deeper horizons will be increased concurrently.

The second factor that has accounted for the industry's major expansion and augurs so well for its future growth is the constantly increasing demand for natural gas as a fuel and as a raw material. Twelve years ago marketed natural gas totalled only slightly over a trillion cu ft annually for the nation whereas, last year it totalled some 2½ trillion.

Forecasting the future is always hazardous but, based upon the present trunk line facilities, the projected pipe lines and taking into account the tremendous unsatisfied demand in areas still without natural gas, I will hazard the guess that the volume of marketed natural gas ten years from now will be double that of today.

The industry sold its gas for some $46 million in 1906; $300 million in 1926; $855 million in 1946 and slightly in excess of $1 billion in 1947. These increases are phenomenal, truly phenomenal, when one considers that natural gas is probably still the most underpriced of all the natural energy resources.

During the past ten years the cost of natural gas to consumers has changed but modestly. Over-all there has been a slight increase but for some uses, particularly domestic, the price on averages has declined. During this same period the cost to consumers for competitive fuels, both coal and oil, has increased sharply. In order to compare properly the cost of the various competitive fuels, it is necessary to reduce all fuels to a common unit of measurement. For this purpose I shall use the "therm," a measurement of heat units equal to 100,000 British Thermal Units. In addition it is necessary to apply a utilization factor, that is the amount of fuel which actually is consumed in most of our present day domestic equipment. This factor approximates 80 per cent for most natural gas, around 70 per cent for No. 2 fuel oil and some 50 per cent for ordinary bituminous coal.

While prices fluctuate in various areas of the nation, in 1938 fuel costs per therm to residential consumers were approximately like this: coal cost 6.2 cents, No. 2 heating oil 7.6 cents and gas 8.6 cents. In 1943 the order was changed and while coal was still the least expensive at 7.2 cents, gas was down to 7.8 cents and fuel oil up to 8.5 cents. By the middle of 1947, the last date for which figures are available, gas was the least expensive costing 7.6 cents, coal was up to 10.5 cents and No. 2 oil up to 13.6 cents. When consideration is given to the overwhelming advantage of gas over either coal or oil in ease of handling, cleanliness and reliability of supply, there is little question but what gas at the present price is the most desirable.

The factors that have held gas prices to the residential consumers at the past levels should continue to exert their effect and it seems likely that the price advantage held presently will, if anything, be increased.

The increased use of petroleum by the nation as a source of energy during the last twenty-five years has also been remarkable. According to statistics compiled by the Bureau of Mines, in 1920 coal provided about 78 per cent of the energy used by the nation, oil and gas provided some 18 per cent and hydroelectric power, approximately 4 per cent. By 1947 coal was down to 48 per cent, oil and gas was up to 48 per cent and hydroelectric power remained at approximately 4 per cent. As a matter of fact, coal production has not even equaled that of 1920 in total volume except in the two years of 1944 and 1947. These statistics do not mean that the production of energy from coal has decreased materially during the period but rather that the major increase in the nation's energy has been furnished by greater utilization of oil and gas.

Of the total amount of energy supplied by oil and gas, which now equals

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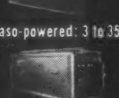

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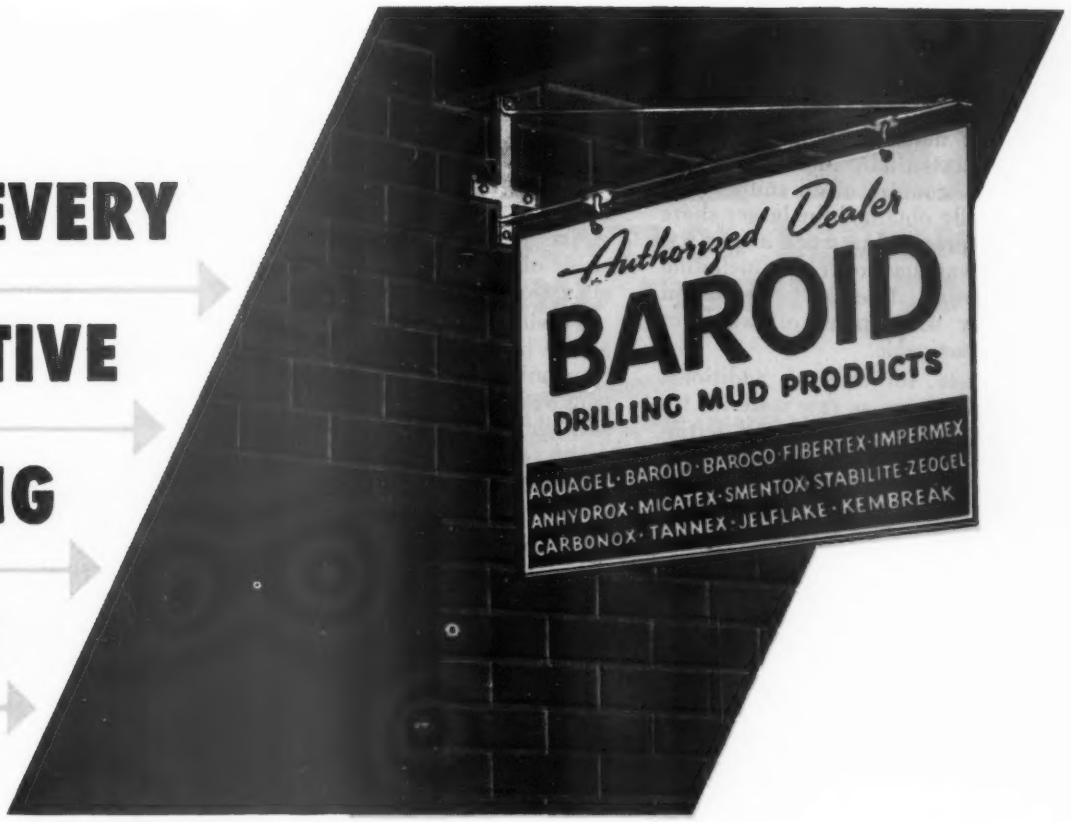
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that of coal, natural gas in 1920 supplied approximately one-fourth whereas, today it supplies about one-third. Therefore natural gas has not only shared substantially in the increased use by the country of oil and gas but has actually obtained the larger share of this increase. Inasmuch as gas has many advantages over oil, including that of price, it seems likely that it eventually will replace oil wherever that is practicable.

Prospects for use of additional quantities of gas as raw material for the increased manufacture of fertilizer, various chemicals and numerous synthetics, all of which are now being produced from natural gas, is especially intriguing. Also it has been proved that petroleum products, such as gasoline, fuel oil, etc., can be produced commercially from natural gas. However, with present techniques and at the present relatively low cost of crude oil, such synthetic processes do not appear competitive.

Possible uses of natural gas seem almost limitless and the non-regulated companies who have conserved and held their gas reserves for future markets should reap large profits. Gas, which only a few short years ago, could not be sold at the wells for 1 cent a thousand cu ft, is now bringing prices as high as 8 to 15 cents a thousand cu ft. What other industry has enjoyed such price increases for its product with an ever-increasing demand which should at least assure maintenance of existing price levels for years to come?

You, gentlemen, are presumably interested in determining what companies, or more exactly, what specific securities are likely to share in the results of additional use of gas and consequently to enjoy appreciation in market value as well as earnings with which to pay dividends. I would be presumptuous and unwise if I attempted to supply the answers as to what securities should be bought or sold. In the first place, I am not in that business and, in the second place, I don't intend to "get out on a limb" and subject myself to red-faced embarrassment if I pick the wrong horse! By the way, though, I have picked a few for my own account and I am searching diligently for more.

There are certain precepts that I have followed to implement my selection of natural gas securities which I hope will assure my participation in the future gowth and expansion of the industry.

The natural gas business has enjoyed most of its expansion under the aegis of government regulation as contrasted to, say, the lusty growth of the railroads during the last century prior to the creation of the Interstate Commerce Commission. This means that such stability as now exists can reasonably be expected to continue. Or perhaps, to put it more tersely, the gas industry has been and is acutely aware of government regulations. Despite this dampening of incentive, the industry has advanced and because of the regulations one may forecast its future more accurately than can be done for many of the other more unfettered industries.

It is apparent that the greatest speculative possibilities are with those companies that do not fall under the present "limited earnings" regulations of the Federal Power Commission or other regulatory bodies. This group includes companies that are producers of natural gas and do not engage in those phases of the business that are subject to such type of regulation. In addition such a classification includes a number of oil companies that control large quantities of gas and a few public utilities that have been able to show to the apparent satisfaction of the various regulatory bodies that a portion of their related operations are not subject to their jurisdiction.

Gas reserves that are generally

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Huber Scrapers, shrink-fitted to new or used sucker rods, scrape paraffin from the tubing wall as the string rotates and reciprocates. This constant scraping prevents paraffin accumulation . . . eliminates paraffin removal.

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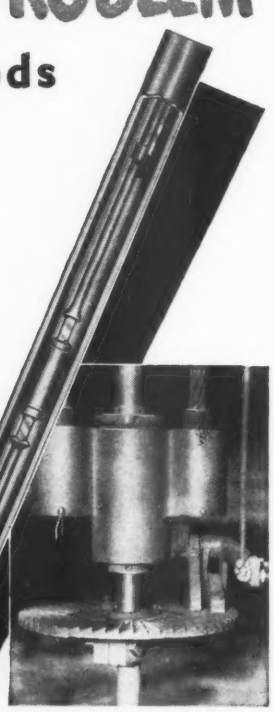

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This rod hanger rotates the rod string a fraction of a turn on each reciprocation. The horizontal teeth on the turn table are engaged by two ratchet levers which are actuated by a flexible steel cable attached to the walking beam. On each reciprocation the levers move the rod string a fraction of a turn.

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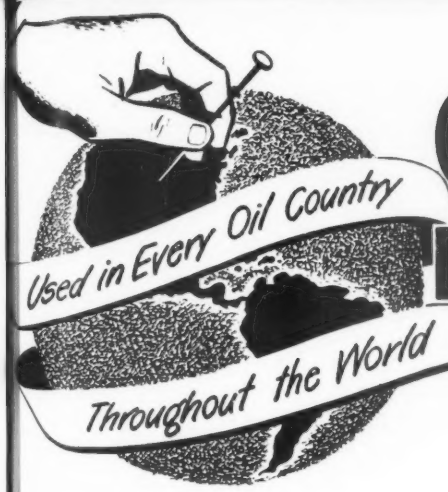

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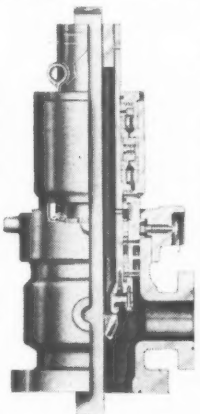

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. . . it automatically expands and contracts to maintain its seal as the various diameters in the drill string are stripped through it — without manual adjustments of any kind.

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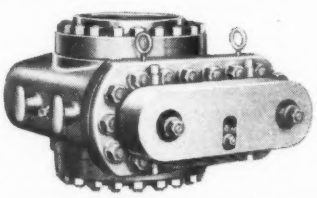

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. . . their rams are opened and closed by positive mechanical drive, insuring quick, simple, foolproof operation!

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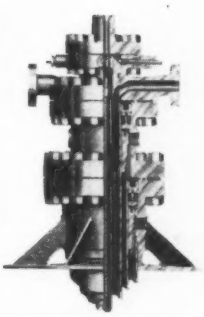

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They are available in many types and various packing arrangements, including types where no internal threads are used for holding the packing element in place, and also types in which all-metal packing elements are used.

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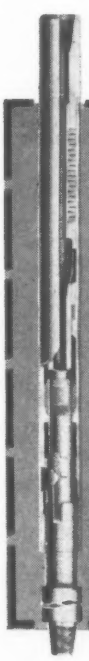
Illustrated at right is the Shaffer Expanding Pin Tap.



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thought of in connection with oil companies, include gas that is dissolved in oil, and gas that is often found in substantial quantities above the oil in many reservoirs. In addition to these types of accumulations, a large portion of the free gas that is not associated with oil, is also owned by oil companies. Most of the fortunate oil companies that share in such type of reserves have made it their policy not to divulge estimates of their gas reserves.

Gas reserves represent important and in some cases greatly understated or even unrecorded values in the balance sheet. This is particularly true of companies with large shut-in gas reserves, the full exploration and development costs of which have been paid already out of past earnings. Such values will begin to reach the profit and loss statement only when these gas reserves are produced and made available in a usable form.

Just how you gentlemen will ascertain what companies hold such valuable gas reserves is something I cannot answer. But it is not an insurmountable problem and I am sure your group, or some of the members of your group, will be able to satisfactorily solve the problem.

The second group of companies whose securities offer perhaps less speculative possibilities but certainly very strong appreciation possibilities, are certain of the gas transmission companies. These interstate pipe line companies are subject to Federal Power Commission regulations and to that extent tend to fall into the public utility category. At the same time this permits comparatively accurate forecasting of earnings for a good many years. The real values in this group of companies lie with those companies that have large "off the line sales" to industrial consumers that are not subject to Federal Power Commission regulations. Such non-regulated sales can add materially to the net earnings of a company. In addition, the capitalization of many of the transmission companies is such as to create a leverage for the common stock. Nearly all the important interstate companies have funded debt and preferred stock that, in total, amount to a large portion of the entire capitalization. You gentlemen are in much better position than I to determine these situations as they now exist or as they may develop.

It appears to me that the long distance transmission of gas is as near to a "sure thing" as exists in business today. It is the only business of which I know wherein one contracts a stipulated price or prices for a period of twenty years to both buy and sell the product. How can the middleman, in this case the long distance transmission line, lose? If a company is formed to build a trunk line, it is supposed to contract for at least a 20-year supply and a 20-year market at agreed prices or a permit to build the line will not be granted by the Federal Power Commission.

There is known to be an almost frantic demand for additional natural gas, both in areas now being supplied and in other areas where there is as yet no supply. The paradox is that well over a billion cu ft of gas a day is being flared and wasted in the oil fields of Texas, not to mention the oil field flares of the other producing states. But as I said before, the natural gas industry has some very shrewd and powerful enemies.

To add facilities to present interstate lines to enable the transportation of more gas or to build new interstate trunk lines to serve the ever-increasing demand for natural gas, the Federal Power Commission must pass on the projects. The practices and procedures of this body require a considerable amount of time. Why? Because lawyers, quite high priced if the truth were known, of the varied but powerful interests opposed to the expansion of present natural gas markets and the opening up of additional natural gas markets vigorously attack and cause delayed and long drawn out hearings on most of the proposals brought before the Commission.

These gentlemen have even attacked the present proved reserves of natural gas as being insufficient to supply the present lines and markets. I had the experience of sitting through portions of one long hearing. It took some 18 months as I recall. Even with only a layman's knowledge of the past and present situations with regard to natural gas reserves, the arguments and delaying tactics, mostly in the form of so-called clarifying questions propounded to witnesses, would appear ridiculous. They would have one believe that the present trunk lines did not have sufficient reserves to supply their commitments. In fact they would have one believe, and they try to convince the public and the staff of the Federal Power Commission, that the supply of natural gas is so perilously low that not even the next few years demands of the present lines will be met adequately.

Nothing is further from the truth but it does remind me of a story having to do with a fuel shortage. In England, where to date they have not obtained a supply of natural gas of any consequence, there was a severe coal supply crisis. The British Government, which uses advertisements extensively to warn, instruct or sometimes pacify the population, gave this eyebrow lifting counsel to the nation's businessmen: The newspaper advertisement read, and I quote, "Owing to the shortage of fuel, employers are asked to take advantage of their typists between the hours of 12 and 2." I have not thought much about it but this story might also be used to bring out more clearly what the enemies of the natural gas business are trying to do to the industry. They have and are continually trying, I quote, "to take advantage," end quote, of the natural gas business.

By the record of the expansion of

(Continued on Page 160)

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Development of Kleiner Pool Revives Interest in Cisco, Texas, Area

By CLARIBEL THOMPSON*

EXCLUSIVE

LONE STAR PRODUCING COMPANY of Dallas, taking the lead in development of the new Kleiner pool, a mile north of Cisco, Texas, is helping to give that old oil town new wealth and an unprecedented building boom. Other operations in the vicinity that are contributing to this new prosperity are those of Manning, Hunt, Woodley, and others farther to the north of this now thriving community.

Harking back to the days of 1917 when Cisco was once the largest town in Eastland county, the current oil field activities have helped Cisco assume the county leadership it lost when the McClesky well blew in at Ranger during these early boom days of 1918. Ranger jumped to a town of 30,000 people at that time while Cisco plodded along with 4868 inhabitants. Eastland also passed up Cisco in population by growing to 10,000.

The tide of oil in those days reached Cisco only indirectly. Shallow pools continued to be developed in adjoining counties. Cisco was the hub of some of these activities, but never the throbbing heart of things that its own recent oil development has made it. The new Kleiner pool has opened up at the very back door of the town to contribute to the building of more than 300 new residences during the past two years alone.

It took a native son to start the boom. As a youngster, Charlie Kleiner helped his dad dig coal out of the very hills now producing a rich flow of oil. In fact, the air shaft for the old coal mine is still there and within less than 200 ft of the Kincaide A-5 well now being completed by Lone Star.

Charlie and his dad sold coal to the townspeople from a wagon in those early days, and worked the farm on the old home place north of Cisco, which is now one of the richest producing leases in the Southwest.

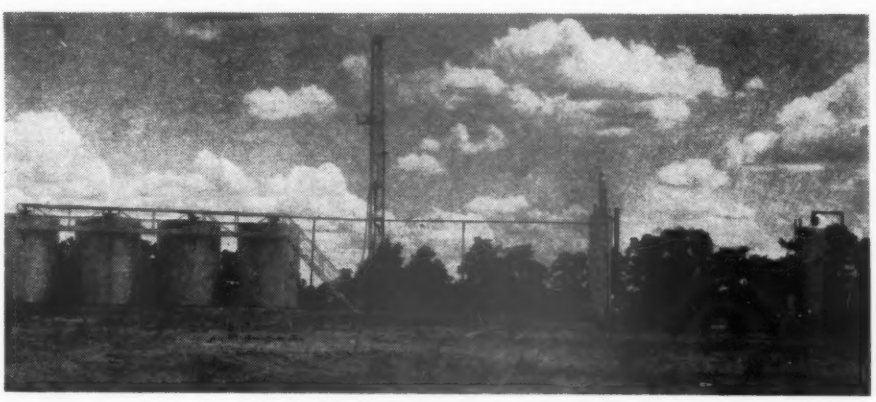
During the Ranger boom, Charlie drove a bus, saved his money and bought a drilling outfit. He took a 40-acre lease, struck oil and started a career that has made millions for himself and new wealth for his home community.

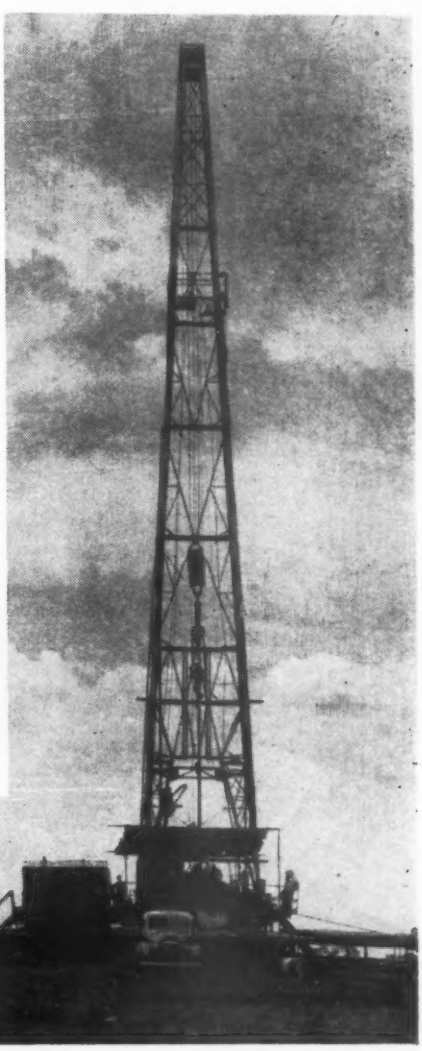
Then he sized up the land adjoining his father's old farm, decided there should be oil under those stubby, post-oak covered hills and acquired a lease on the property. He intended to drill there but ill health held him back.

That's when he closed the deal with Lone Star Producing Company. In the meantime the Kleiner field structure had been located and mapped by the Lone Star Geological Department while doing surface geology in the Cisco area.

The structure was so mildly reflected in the surface rocks, however, that it seemed hardly to merit a test without further confirmation. Late in 1947 it was decided to check this sur-

*Lone Star Gas Company.





Above are storage tanks for Lone Star Kleiner A-1 well, left, right center, treater and, far right, separator. In center background can be seen drilling rig for the Kincaide A-4. Kleiner A-1 was completed June 24, 1948, proving existence of oil and gas in new Kleiner field and confirming structure.

Right, Lone Star's Kincaide A-4, third well drilled in new Kleiner field, was completed with a potential of 310.88 bbl oil and 389,000 cu ft gas. Kincaide A-5 is now completed.

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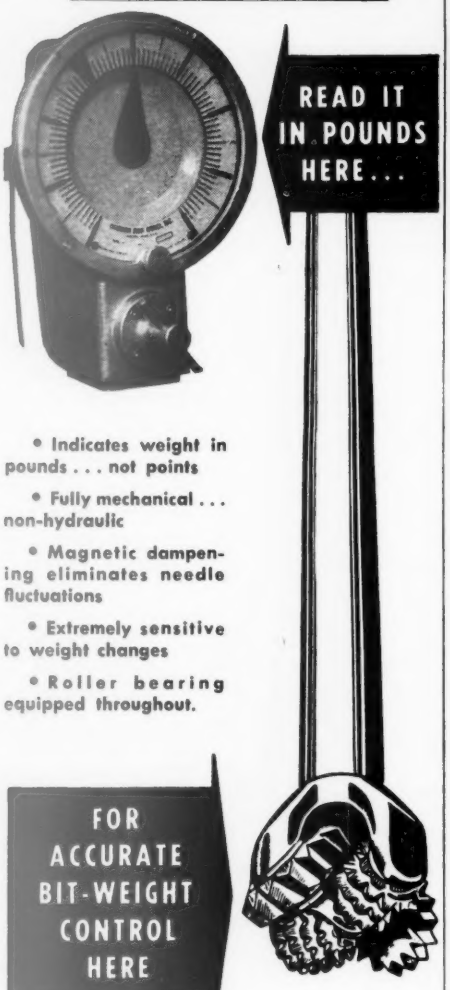

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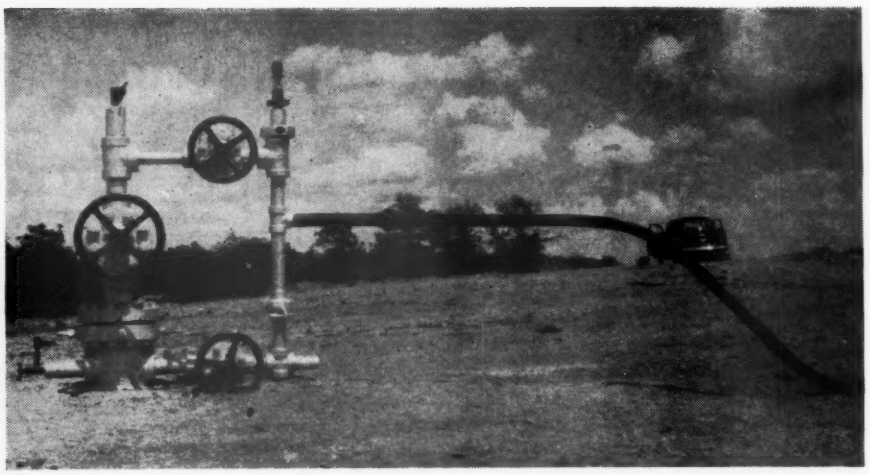

Christmas tree on Charles Kleiner A-1 well, which feeds the tanks.

face structure with a seismograph survey. The survey not only confirmed the surface structure, but indicated that at a depth of 3000 to 4000 ft the structural conditions were highly accentuated over those indicated at the surface. From this information it was concluded that there were possibilities of a Mississippi limestone reef overlying the Ellenburger limestone and plans were made to test the structure.

At this time the Kincaide A-3, on the edge of the structure, was about to be deepened from the lake sand to the Ranger sand that was producing in an offset well. It was decided to carry this well to the Ellenburger limestone and, in doing so, the presence of the Mississippi limestone reef was established. This was in December, 1947.

On June 24, 1948, Lone Star Producing Company completed the Kleiner A-1 on the lease obtained from Charlie Kleiner. The well definitely proved the existence of oil and gas, confirming also the structure that had been indicated by surface geology several years before. The Kleiner spudded on May 23, tested 204 bbl per day through a 20/64th-in. choke at 4014 ft in Mississippi limestone. The well penetrated 340 ft of the Mississippian, and oil field "grapevine" had it that the well would have been a 15,000 to 20,000 bbl gusher back in the boom days when wells were allowed to flow wide open.

Drill stem tests in top of the Mississippi from 3699 to 3769 ft obtained gas immediately at a minimum rate of about 10,000,000 cu ft daily. Another test from 3790 to 3816 ft with the test tool open 8 min obtained gas at about the same rate as the initial test. First oil production was obtained on drill stem test from 3910 to 4000 ft. This test flowed oil in 7 min and gas at the rate of 734,000 cu ft per day.

The discovery well, the Kincaide A-3 was an old gas well drilled about 1930. When deepened it tested 689 bbl per day through 28/64-in. choke from casing perforations between 4024 and 4030 ft. Although known as the Kincaide tract, this is on the old home place of the Kleiners.

Lone Star Producing Company has drilled five wells so far in the Kleiner Mississippian limestone pool. The Kleiner A-1 has a potential* of 204.6 bbl of oil daily and 98,000 cu ft of gas; Kleiner A-2 has a potential* of 118.32 bbl of oil and 612,000 cu ft of gas; Kincaide A-3 has a potential* of 688.88 bbl of oil and 404,000 cu ft of gas; Kincaide A-4 has a potential* of 310.88 bbl oil and 389,000 cu ft gas; Daniels No. 1 has a potential* of 303.92 bbl oil and 286,000 cu ft gas; and the Kincaide A-5 is now being completed.

Other operators in the Kleiner field include Hickock and Reynolds, Inc., Sam Killingsworth, and Alsabrook and Kemp.

The Kleiner pool is about a mile wide and a mile and one-half long. And Cisco, which also is seeing oil development on the grounds of its junior college, has jumped back into the lead in county population.

The 1947 figures rate Cisco at 7000, and local claimants say it is nearer 8000 now. Eastland, by 1947, had dropped back to 5000 and Ranger to 5500.

Designation of the new producing area as the Kleiner field was granted by the Texas Railroad Commission on request of Lone Star. At the same time request was made for discovery rights and an allowable of 100 bbl per day on the first six wells. A ruling on September 1 of this year set the MER ("maximum efficient rate") at 73 bbl a day for this field. * * *

*As determined for the Texas Railroad Commission through a small choke.

6*

star performer in a *dual role*

From an operating standpoint, the equipment and techniques for completing, separating, and producing more than one horizon through the same well bore must be simple and dependable. From an economical standpoint, the use of this equipment must prove itself to be a definite and sustained improvement over other methods. Otis Side-Door Chokes and supplementary equipment meet these basic requirements with clear-cut success.

The diagram on the right illustrates Otis two-zone equipment in a standard dual role. A Side-Door Landing Nipple, installed as part of the tubing, furnishes a horizontal flow course (through four ½" ports) between the tubing and tubing-casing annulus. A Side-Door Choke has been run, under pressure on a steel measuring line, and set in the Nipple to close the ports and separate the two zones. The lower zone is producing through the tubing, while the upper zone produces through the annular space.

There are more than 18 different standard applications of Otis Side-Door Chokes and supplementary single and two-zone equipment, including killing a well or reconditioning mud above the packer in single or two-zone wells; taking separate bottom hole pressures of each zone through the tubing of two-zone wells; acidizing each zone independently of the other; and kicking off the upper zone of two-zone wells.

No other organization in the petroleum industry is better qualified to discuss the mechanical and economical aspects of two-zone completion and production than Otis Pressure Control, Inc. Whether it's a single well or a unit program, call the Otis man nearest you. He will be glad to make available to you Otis knowledge and experience in this type of specialized work, and explain in detail the possible application of Otis equipment to your specific two-zone problems.

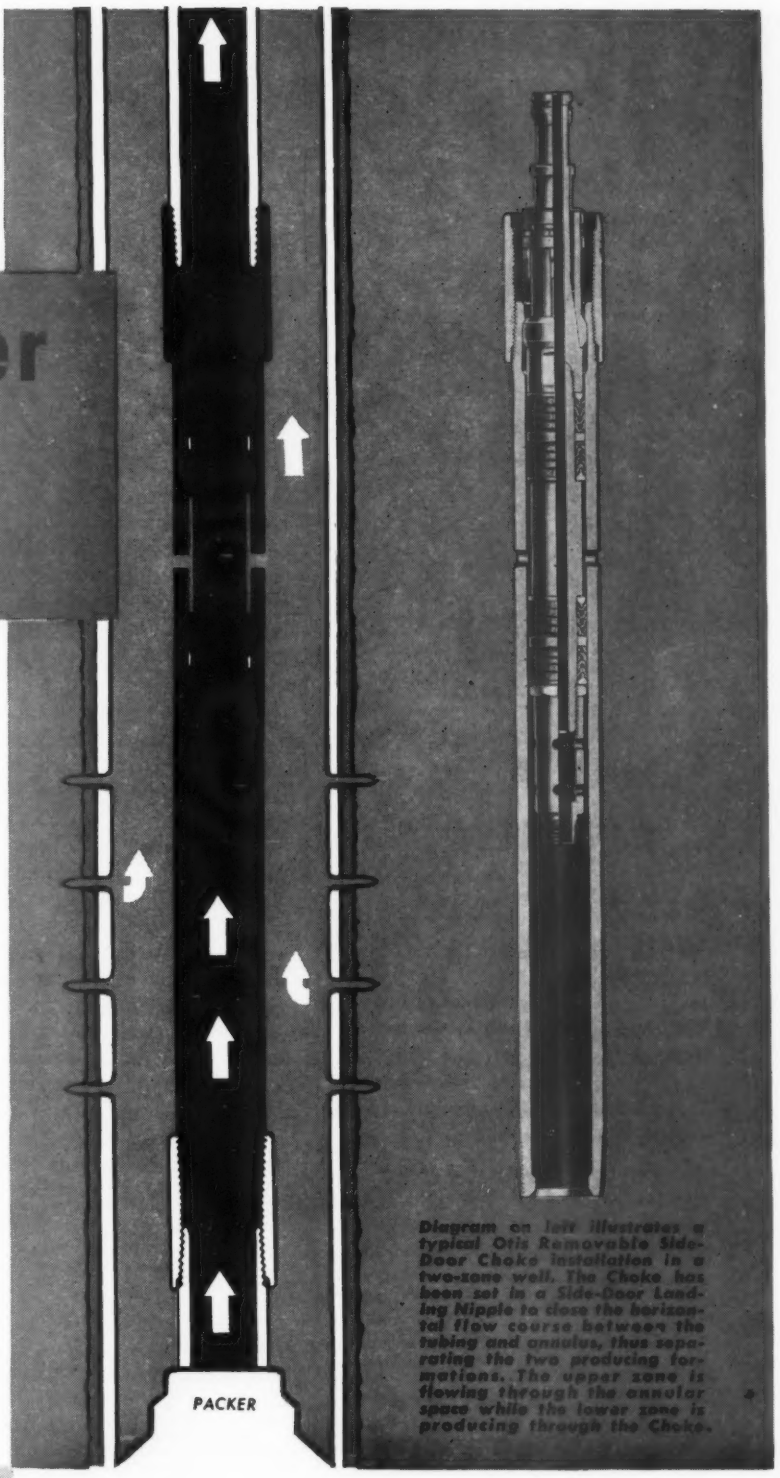

Diagram on left illustrates a typical Otis Removable Side-Door Choke installation in a two-zone well. The Choke has been set in a Side-Door Landing Nipple to close the horizontal flow course between the tubing and annulus, thus separating the two producing formations. The upper zone is flowing through the annular space while the lower zone is producing through the Choke.

***NO. 6** *in a series of high-pressure production problems and practices and the allied use of Otis Surface and Sub-Surface Controls and Services. Reprints of this series, suitable for filing, are available upon written request to Otis Pressure Control, Inc., Box 7206, Department A, Dallas, Texas.*

LITERATURE AVAILABLE

"Otis Removable Side-Door Chokes," a sixteen page, four-color, illustrated catalog describing in detail the varied applications and functions of all types of Otis two-zone completion and production tools and equipment. Also available are reprints of an article, "Pumping Two-Zone Wells." Write to address shown above.

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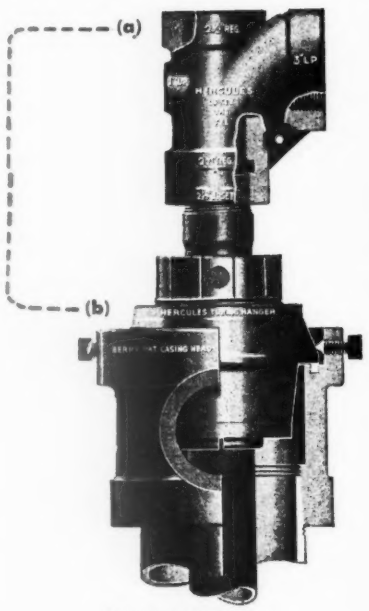

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(Continued from Page 154)

the industry they have not been successful. However, they have prevented and by their delaying tactics have kept many projects bottled up in long drawn out hearings and sometimes even in court cases. This brings up another story. In a recent court case the adversaries of the expansion of the natural gas industry were endeavoring to convince a Detroit judge and jury that the introduction of additional natural gas into the territory would seriously affect the interests of the coal industry and the railroads serving that territory. The judge, after hearing the arguments of the counsellors, remarked, and it should be remembered this happened in Detroit, "This case has about as much merit as a case which was tried some 40 years ago in this Court. It had to do with the buggy manufacturers trying to stop the production of automobiles."

The production and long line transmission phases of the natural gas industry are sound, bankable businesses. These two phases of the natural gas industry, and I have tried to limit my remarks to these as I do not have more than a layman's knowledge of the other phases of the natural gas industry, are mature and well seasoned. However, a word of warning: These statements are applicable only to those companies that have adequate gas reserves and efficient "know how" executives to plan and manage the operation.

Given adequate gas reserves in one part of the country and a definite increasing demand—it has been an almost insatiable demand—for natural gas in another portion of the country, the profitable linking of the two by a transmission line becomes a mechanical problem provided the executive management is of the "know how" efficient type.

To sum up these remarks, I should like to reiterate that I believe the natural gas industry, speaking now of the production and transmission phases, is a sound industry.

If one considers the present tremendous proved natural gas reserves, the sure fact that additional reserves will be proved for production and the fact that natural gas is practically a fuel without a peer, there should be but little doubt that the industry will be successful in expanding its operations. I personally think the natural gas industry will improve and materially so, its relative rank as an income producer. I say this reservedly, however, because as I have said before, continued success and continued expansion of the industry will depend to a great degree on how management conducts the battle—and fight it will be—against the maneuverings of the powerful and skillful enemies to the continued expansion of the natural gas markets. But, if that great benefactor of the natural gas industry, Mr. John L. Lewis, continues in his strange and wondrous ways, the market for natural gas certainly will double in the foreseeable future.

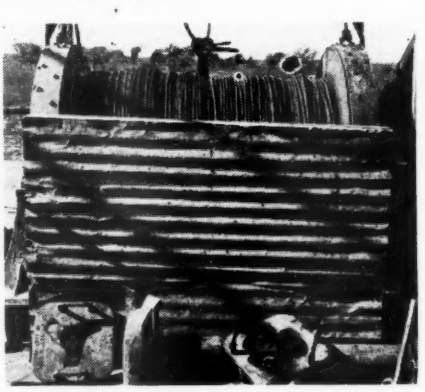
I do not think that even he and his cohorts can, as so aptly stated by General Ernest O. Thompson, present chairman of the Texas Railroad Commission, quote, "continue forever to keep the American housewives in those areas not now served by natural gas, tied down to a coal scuttle and an ash can," end quote. ★ ★ ★

Improved Guard Protects Sand Line Reel

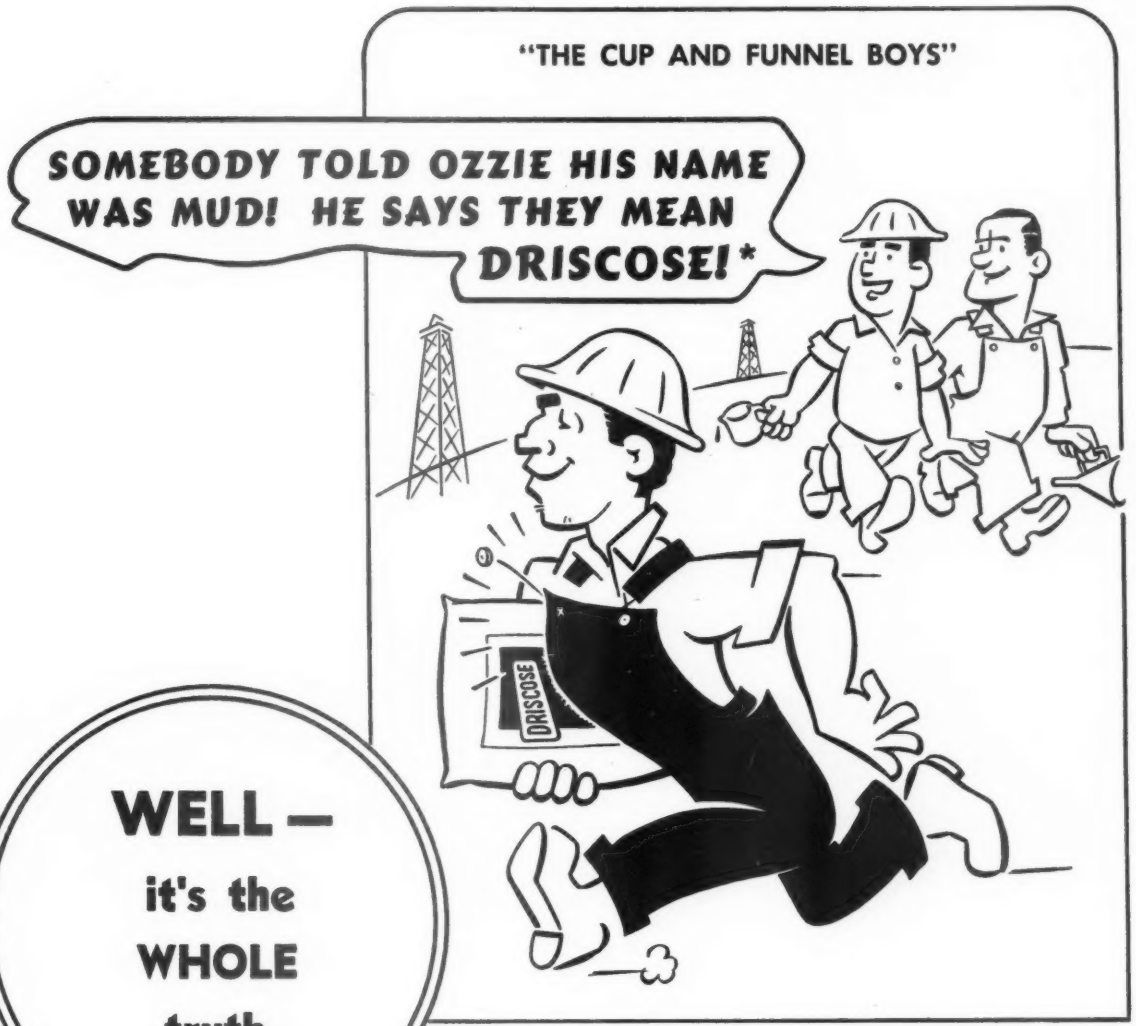
To protect his sand line reel from damage one drilling contractor uses a shield of timber, wide enough to span the two brake drums of the unit. The front of the shield is covered with corrugated roofing, to prevent mud and water from being splashed on the line and brake linings when the rig floor is hosed down.

The timber frame is made strong enough to fend off bits, subs and other parts of drilling equipment. The unit more than pays for itself the first time it protects the sand line from damage, as any injury to the line from falling material occurs on the outside wraps, in which breakage might result in equipment lost down the hole.

The guard also acts to prevent mud being slung across the derrick floor when the sand line is being reeled in or re-run, as well as preventing crew personnel from inadvertently walking within reach of the line when the reel is spinning rapidly.



"THE CUP AND FUNNEL BOYS"



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NEWS

Jester on Tidelands

The tidelands situation will be discussed by Governor Beauford H. Jester in his annual report as chairman of the Interstate Oil Compact Commission at that organization's meeting in Wichita, Kansas, December 10 and 11.

Under Governor Jester's leadership the Compact Commission has agressively called attention to the advantages of state ownership of the submerged offshore oil lands, Earl Foster, executive secretary pointed out. "Governor Jester is recognized as an outstanding authority on the subject. He appeared before a Senate committee earlier this year urging Congressional enactment of legislation affirming state title to the properties. The Compact by resolution has endorsed the principle of state ownership."

"The effort of the federal government to take from the states properties to which they have held undisputed title since the founding of our nation is one of vital concern to every American citizen," Foster said. "The question will be before Congress when it reconvenes in January and we must see that they have the true facts with reference to this all important matter."

SEG Nominees

Nominees for offices of the Society of Exploration Geophysicists are as follows: for president, M. M. Slotnick, Humble Oil and Refining Company, Houston vs Andrew Gilmour, geophysicist with Amerada Petroleum Corporation; for vice president, Roy L. Lay, assistant manager of the geophysical division of The Texas Company, vs George E. Wagoner, exploration manager of Carter Oil Company's southern division at Shreveport; for editor, Sigmund Hammer, geophysicist with Gulf Research and Development Company at Pittsburgh, Pennsylvania, vs Richard A. Geyer, research geophysicist with Humble at Houston. Results of the mail ballot will be announced at the annual meeting next March in St. Louis.

Opens New York Office

Jack Ammann Photogrammetric Engineers of San Antonio, Texas, aerial mapping firm, announces the opening of a new eastern office at 34 Webster Avenue, Manhasset, New York. William H. Meyer, Jr., photogrammetric expert who has been en- will be the manager of the new office.

James D. Harris

Core Lab in Denver

Core Laboratories, Inc., national petroleum reservoir engineering firm, announced the opening of permanent offices in the U. S. National Bank Building in Denver, Colorado. James D. Harris, district engineer, will direct the company's drill cuttings and core analysis activities in the Rocky Mountain area. Permanent laboratory facilities have been established in Worland, Wyoming, and a large part of Core Lab's new equipment now being constructed under a $250,000 expansion program has been designated to service Colorado, Wyoming, and Montana drilling operations.

New Drilling Company

Dan L. Reynolds is president of newly organized Buffalo Drilling Company, Jackson, Mississippi. Wiley Wedemeyer and Frank E. Davis, both from Patrick-Tyrrell Company, have joined the new company as vice president and secretary-treasurer, respectively.

Streamlined Magazines

The four Petroleum Engineer magazines to be published beginning January, 1949, will be:

1. The *Petroleum Engineer*—all divisions. This will include all sections.
2. *The Petroleum Engineer Exploration, Drilling, and Production Magazine,* which will include the first two sections.
3. *The Petroleum Engineer Refining and Gas Processing Magazine, which will include General Section and Refining.*
4. *The Petroleum Engineer Pipe Line and Marine Transportation Magazine, including General Section, and Pipe Line and Marine Transportation.*

North Cowden Gas Injection Program

Permanent organization of the Grayburg Producers committee, an operators' group formed to carry out the gas injection program in the North Cowden field of West Texas, was recently completed.

T. B. Campbell, Stanolind Oil and Gas Company, Midland, Texas, is the new chairman. Other officers are: A. S. Rhea, Sun Oil Company, Dallas, vice-chairman; Lloyd Holsapple, Sinclair-Prairie Oil Company, Fort Worth, secretary-treasurer.

The 20-year high pressure injection program was formulated to increase oil recovery from the Grayburg lime in the North Cowden field. Operators participating in the program include nearly all who are active in the field.

The committee will engage a full-time field engineer to coordinate the gas injection operations and keep engineering data on the project. He will be located in the committee offices in Midland. Personnel of the member companies will serve on the engineering sub-committees.

Organize Oil Company

W. J. "Swede" Larson, formerly manager of California field operations for the Union Oil Company, announces the formation of the Yellowstone Oil Company, of which he is president. The first project will be the drilling of a well in the Santa Maria Valley, to spud in the very near future.

The offices of the Yellowstone Oil Company are in Room 1000, Bankers Building, 629 South Hill Street, Los Angeles.

Appointments Made

The appointments of Gerald G. Baker as research chemist and Thomas B. Heck as service engineer have been announced by George Miller, president of Oil Base, Inc. Baker will act as a liaison between field engineers and the laboratory on field problems as well as testing and developing the company's new products. He will be stationed at the home office laboratory at Compton, California. Baker received his degree in chemistry at the University of Arkansas and served with the Navy radio communications during the war.

G. G. Baker

Heck will cover the Texas and Louisiana territories out of the Houston office. He is well acquainted with drilling problems in the Gulf Coast, having previously served as production engineer for Visco and Baroid Sales.

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"Prevention of Deterioration Abstracts" Available

The National Research Council of the National Academy of Sciences (Prevention of Deterioration Center, Room 204), 2101 Constitution Avenue, Washington, D. C., offers the 'Prevention of Deterioration Abstracts' on a yearly subscription basis. These Abstracts are classified under the following headings: Biological Agents; Electrical and Electronic Equipment; Fungicides and Other Toxic Compounds; Lacquers, Paints and Varnishes; Leather; Lubricants; Metals; Miscellaneous; Optical Instruments and Photographic Equipment; Packaging and Storage; Plastics, Resins, Rubbers, and Waxes; Textiles and Cordage; Wood and Paper. Cross references are included in each issue; author and subject indexes are compiled at the conclusion of each volume. Material for the Abstracts is obtained from journal articles, patents, and unpublished reports from government, university, and industrial research groups both here and abroad.

Approximately 2000 pages are published a year, in two volumes of six issues each. The individual abstracts are in loose leaf form so that they may be arranged in any manner desired by the individual receiving them. Comments are added to many of the abstracts to correlate relevant information, to evaluate reports, or to make suggestions for further research.

The yearly subscription rate, which includes two sturdy binders and index guides, is currently $37.50. The rate will be $50.00 for requests received after July 1, 1949. All subscriptions run from July 1st to June 30th. Back issues are available from April 1946 when the series was started.

An 'Advance List,' a monthly bibliography of all the reports received in this field by the Prevention of Deterioration Center is also available for an additional $10.00 per year.

Osborn to China

Campbell Osborn recently arrived in Shanghai to take charge of the petroleum program of the Special ECA Mission to China. Osborn was for many years assistant to the president of what is now Continental Oil Company. He was also in the oil producing business from 1927 to 1932 with Ralph Bard, wartime Assistant Secretary of the Navy. He was wartime Assistant Chief of the Chemical Division of the War Production Board, and served with General MacArthur in charge of manufacturing industries.

AIME-Texas U. Meeting

The Texas Local Sections of the AIME will conduct a joint technical meeting on December 16-17 at the University of Texas. The petroleum engineering faculty and students of the university will serve as hosts for the meeting, which is alternated annually between the university and Texas A&M College to bring the students into closer contact with engineers in the exploration-drilling-production industry.

The program will be composed of papers secured by each of the five local sections: the Gulf Coast Section (Houston, George L. Nye, chairman); Southwest Texas (Corpus Christi, Henry N. Lyle, chairman); East Texas (D. W. Akins, Jr., chairman); North Texas (Dallas, Fort Worth, Wichita Falls, Warren J. Jackson, chairman); and Permian Basin (Midland, Odessa, Burton Atkinson, chairman). Dr. H. H. Power, chairman of the university's petroleum engineering department, is coordinating the program efforts of the sections. A banquet on December 17 will climax the meeting.

Carver to Colorado

George Carver, Kerr-McGee geologist, has been moved from headquarters at Dumas, Texas, to Grand Junction, Colorado.

LOG WHILE YOU DRILL...
Geograph logs foot by foot . . . 24-hours a day . . . shows formation changes, drilling depth and down time - - at all times!
Geograph saves in many ways for both large and small operator! Write for details now!
"TIME WILL TELL"
THE GEOLOGRAPH CO. INC.
P. O. Box 1291 Oklahoma City 1, Okla.

Why Guess
ABOUT WIRE LINE MEASUREMENTS?
Easy to Carry
Direct Reading
Quickly Put on Line
Accurate Measurements
The Cavins DEPTHOMETER is a simple, compact, direct-reading device that obsoletes "stringing-in" and gives you accurate measurements in very little more time than it takes to make a trip with your bailer. Comes in a handy carrying case (weighs only 17 pounds)—readily taken to any well—put on the line in a few seconds—priced to pay for itself quickly.—Write for illustrated folder.
THE CAVINS CO.
2853 Cherry Ave., Long Beach 6, California
CAVINS DEPTHOMETER

TO THE OILMEN OF TODAY AND TOMORROW

Merry Christmas!

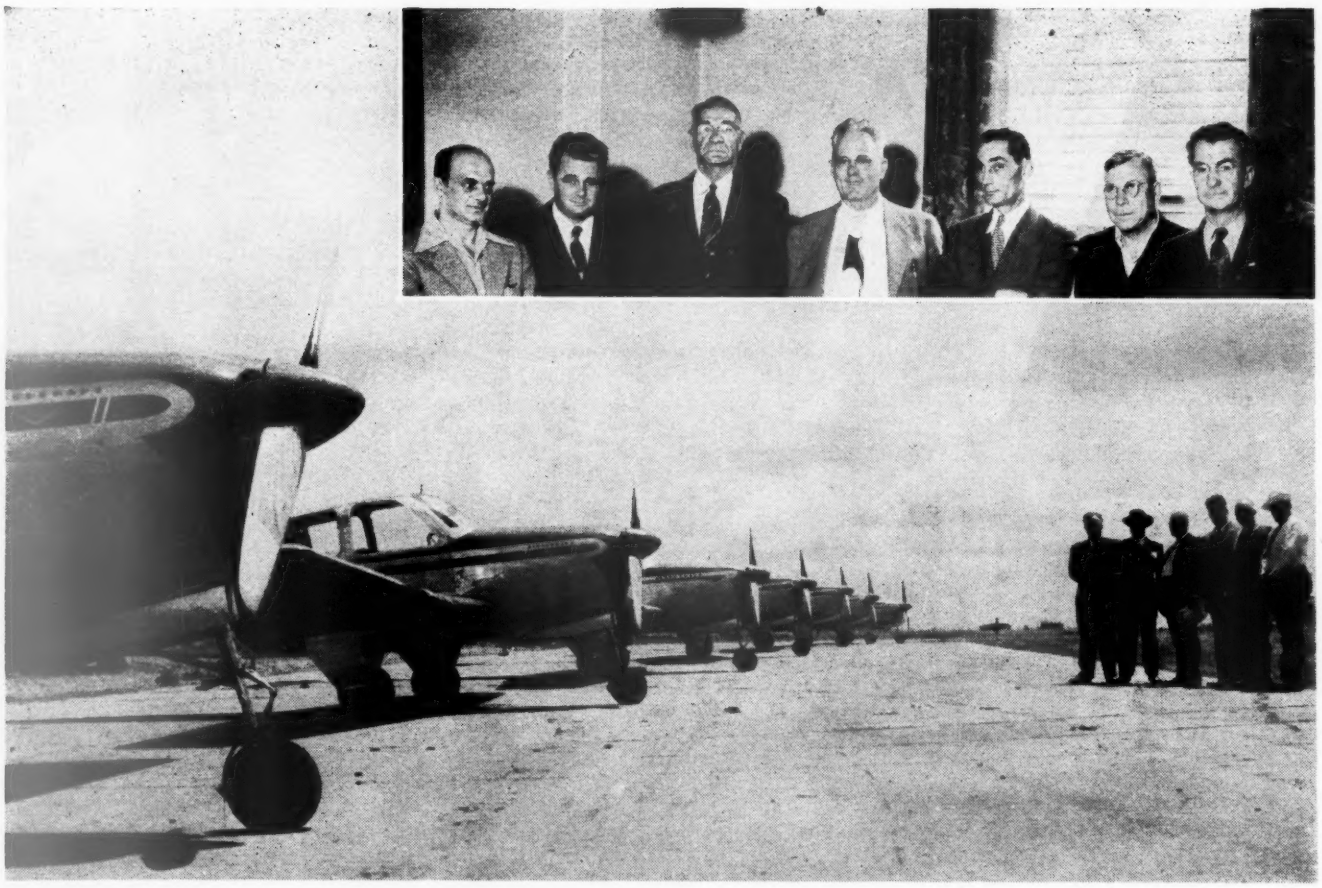
The year's most glorious day---Christmas!---when business cares are put aside and youth takes over.

It is our most sincere wish that this Holiday Season be the merriest you have ever known... and that the New Year bring you greater success and full happiness.

THE CONTINENTAL SUPPLY COMPANY

Serving the Oil and Gas Industries

Since 1912



Weatherford Spring Company Operates Fleet of Seven Four-Place Planes

"Operating 'The Red Fleet' of seven Beechcraft Bonanzas, Weatherford Spring Company owns the largest number of these four-place personal planes used by any business organization in the United States." This statement recently appeared in *The Beech Log*, house publication of the Beech Aircraft Corporation.

Weatherford Spring Company of Weatherford, Texas, manufacturers of oil well cementing tools and other specialties, announce the purchase of seven Beechcraft Bonanzas to facilitate the operations of their field men and to speed delivery of materials vital to oil well completion jobs.

In the accompanying photograph officials of the Weatherford Company (standing) are seen accepting delivery of these planes from Beech Aircraft officials. Left to right: John A. Hall, sales manager; Jess E. Hall, Jr., general manager, and Jess E. Hall, Sr., owner of the Weatherford Spring Company; J. D. Reed, Beechcraft distributor of Dallas; Walter H. Beech, president and chairman of the board, and Lee H. Smith, sales manager of Beech Aircraft Corporation.

An interesting sidelight on this recent development at Weatherford Spring Company was the meeting in Los Angeles in July of this year of the seven men shown in the inset photograph. These men, together for the first time in 13 years, all had a part in the manufacture of the first scratcher invented by Hall in 1934. Scratchers were first used in the Weed Patch oil field near Bakers field in 1935. Left to right they are: Clay Miller, George Hall, Ralph Hall (no family relation to Jess Hall), Jess E. Hall, Sr., Art Brumbly, Roy Swearinger, and Carl Parks.

Contract for Pumps

This year, the city of Cincinnati awarded Worthington Pump and Machinery Corporation the contract for six electric-driven centrifugal pumps, with motors and controls, for the new Tennyson Avenue Pumping Station. This is part of Cincinnati's five-year multi-million dollar improvement program. The new pumps will make available to the city 150,000,000 gal of water per day, in addition to the present 165,000,000.

Two of the new pumps will be two-stage, powered by 3000 horsepower General Electric motors; each capable of delivering 25,000,000 gal of water daily to the Eastern Hills system, at about 200 lb pressure. One two-stage pump, for Eastern Hill's variable speed service, will be rated at 20,000,000 gal per day. This unit will be driven by a General Electric 2500 hp variable speed motor.

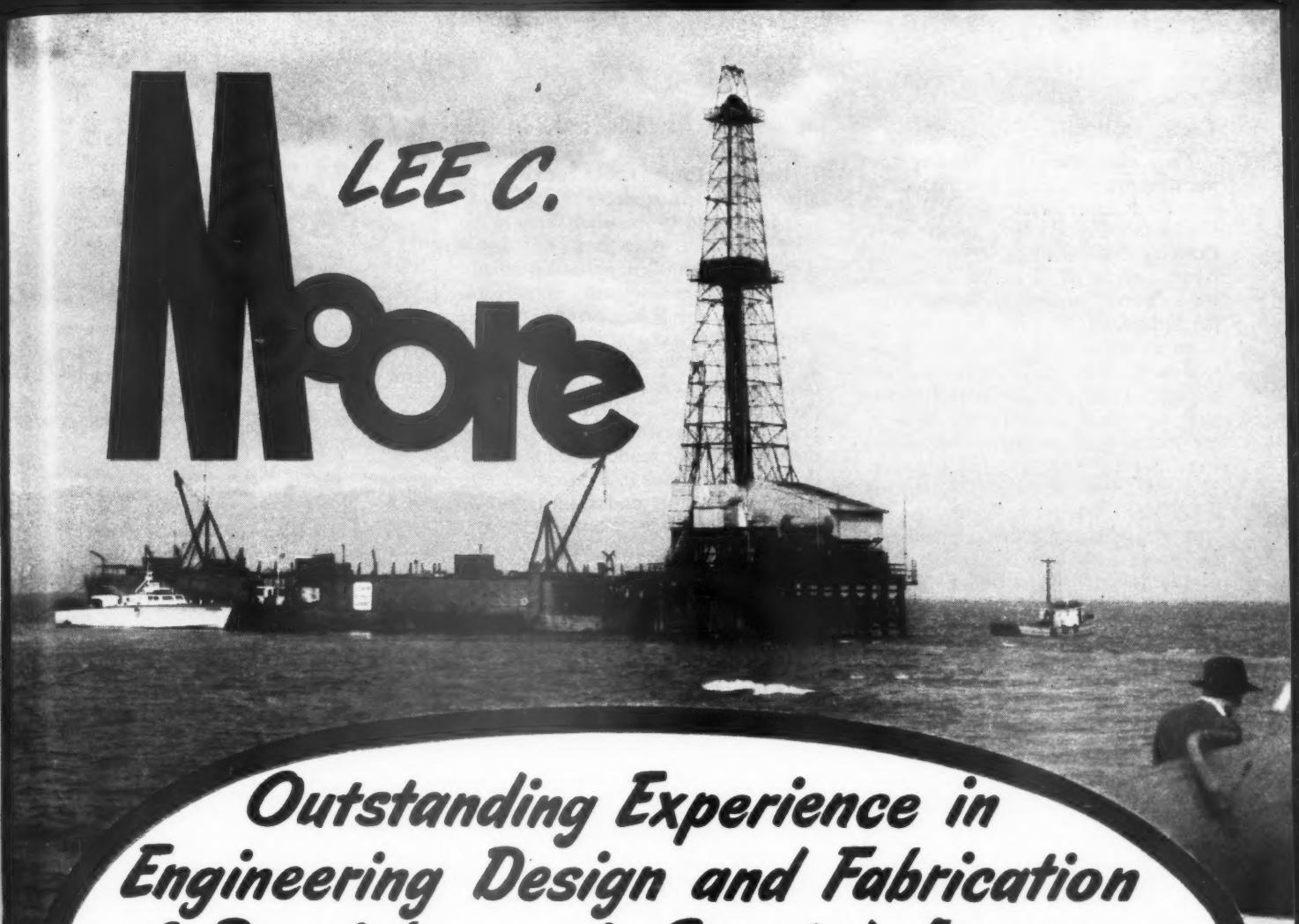
Three single-stage pumps, rated at 25,000,000 gal per day will be powered by General Electric motors, each of 1250 hp, and will supply 75,000,000 gal at 75 lb pressure to the Central Service System.

The General Electric Company will supply controls and accessory equipment for all the pumping units.

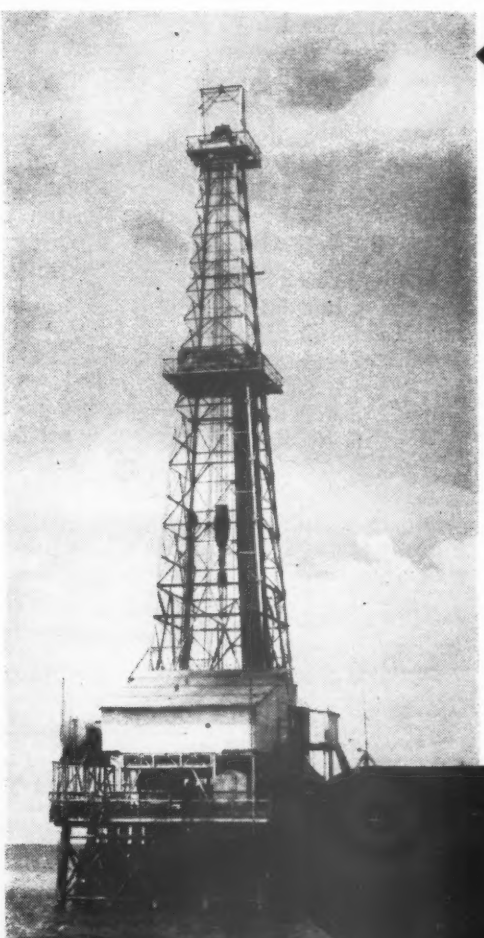
Joint Agreement

A joint agreement between Frederic Flader, Inc., North Tonawanda, New York, and Clark Brothers Company, Inc., Olean, New York, one of the thirteen member companies of Dresser Industries, Inc., has been entered into whereby Clark Brothers will manufacture and distribute gas turbines and axial compressors of the Flader design for general industrial use. The agreement contemplates that Flader will be responsible for research, engineering and design and that Clark Brothers will manufacture and market these products.

LEE C. Moore



Outstanding Experience in Engineering Design and Fabrication of Derricks and Special Accessory Structures for Off-shore Drilling..



Lee C. Moore's valuable experience in engineering and fabricating Heavy Series Derricks, with standard and special structures, for deep water drilling extends our progressive service.

Court Ruling

The United States Federal Court for the western district of Louisiana rendered a decision in the case of Jesse E. Hall versus B & W, Inc. Judge Gaston Porterie dismissed the action for infringement of Hall patent 2,220,237 for a Spiral Centralizer, holding that the defendant, B & W, Inc., was entitled to manufacture and sell same.

B & W, Inc., manufacture and sell scratchers and straight centralizers as well as spiral centralizers. B & W scratchers and straight centralizers were not involved in the litigation. The effect of the decision is that B & W, Inc., may manufacture and sell both straight and spiral centralizers free from any claim of Jesse E. Hall who is doing business under the firm name of Weatherford Spring Company.

Howland Named to Ad Post

Appointment of Joseph G. Howland as advertising and sales promotion manager for Motorola Inc., Chicago, Illinois, was announced by Paul V. Galvin, president.

Howland recently resigned as director of advertising for the domestic appliance division of Pressed Steel Car Company, Inc., Chicago. He succeeds Victor A. Irvine, who recently announced his retirement because of his health.

Galvin also announced that Robert J. Flanagan, who was assistant to Irvine, has been promoted to the position of assistant advertising and promotion manager.

Visits Europe

Fred M. Young, president of Young Radiator Company, Racine, Wisconsin, returned to the United States in September. He accompanied the Wisconsin Trade delegation composed of Wisconsin industrialists on a tour of the Scandinavian countries, Norway, Sweden, Denmark, and Holland. The delegation left the United States on August 16. Young extended his trip to cities in Switzerland, France, England, and Ireland.

Young was impressed by the cordial attitude of a number of the countries. He stated that Norway, Denmark, and Holland particularly, were making an all-out effort to clean up their affairs and to get back into a good position again by improving their economy. They are very anxious to receive any aid that they could and to work cooperatively with the United States. Special attention, during Young's visitation, was given to manufacturing in the various countries.

The European people in general are very much worried about the possibility of another calamity in the way of war. They would like to adjust their circumstances to get back to normal living and to get their economy in shape for world trade. The delegation was interested to see what these countries produced, what they needed and the general condition of their political, living and manufacturing conditions.

Young said that prevailing labor conditions in some of these countries has acted as an obstruction against obtaining end results. Because of this, production that should be accomplished and that which is actually produced is highly inadequate. Some of the people still are in a daze from the effects of the war and from the regimentation of their governments. The control is so complete that a citizen oftentimes does not know which way to go to do things to get results. It is believed too much control, too many laws often work reversely on a government or peoples or a facility and the countries of Europe are suffering from this in many ways.

All of this reflects the political changes in the government and setups of control. Many things are to the point where nothing much can be done because of the absolute control vested through the government's handling and the many offices one has to go through to get a license to accomplish a given work.

New Perforating Gun

John Ed Cooper, sales manager for The Western Company, Midland, Texas, announces new gun perforating services for that company involving the use of a bullet gun designed on the "folded-barrel" principle. It allows use of up to 100 per cent longer barrel and 30 per cent more powder than some other guns now in use in the oil fields.

Grove Opens Houston Branch

A new southwest factory branch has just been opened by Grove Regulator Company of Oakland, California. The new office and warehouse will be at 3608 Navigation Blvd. in Houston, Texas. According to M. H. Grove this branch will service the entire Mid-Continent and Gulf Coast areas. The new sales and service branch will be staffed with experienced field engineers who are thoroughly qualified and trained in the application of Grove regulators and valves, designed for manual and automatic pressure and flow control.

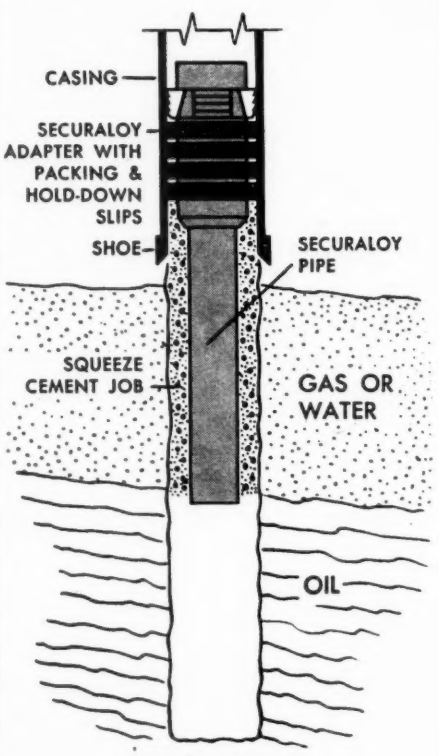
M. H. Grove

USE OF SECURALOY SOLVES MANY PRODUCTION PROBLEMS

Securaloy pipe, which may be removed with chemicals or a drilling bit, is being used to solve many "difficult" production problems, such as correcting gas-oil ratios, water shutoffs and plug backs.

CORRECTING GAS-OIL RATIOS

This method is similar to that used in the case history shown on the opposite page except that the Securaloy pipe extends through the gas zone to the top of the oil zone.



Securaloy set on top of producing zone

This method is used where the entire oil zone can be produced from open hole and where it is not necessary to confine the oil production to selective strata. The hole through the oil zone is first filled with gravel. Securaloy pipe is run and squeeze cemented in position. When the cement has set, Securaloy cementing shoe and gravel are cleaned out and well is ready for production, with gas or water successfully under control.

SECURITY ENGINEERING CO., INC.

ONE OF THE DRESSER INDUSTRIES

Main Office and Plant: Whittier, California
Branches in all of the major producing areas
Export Office: Chanin Building, New York City

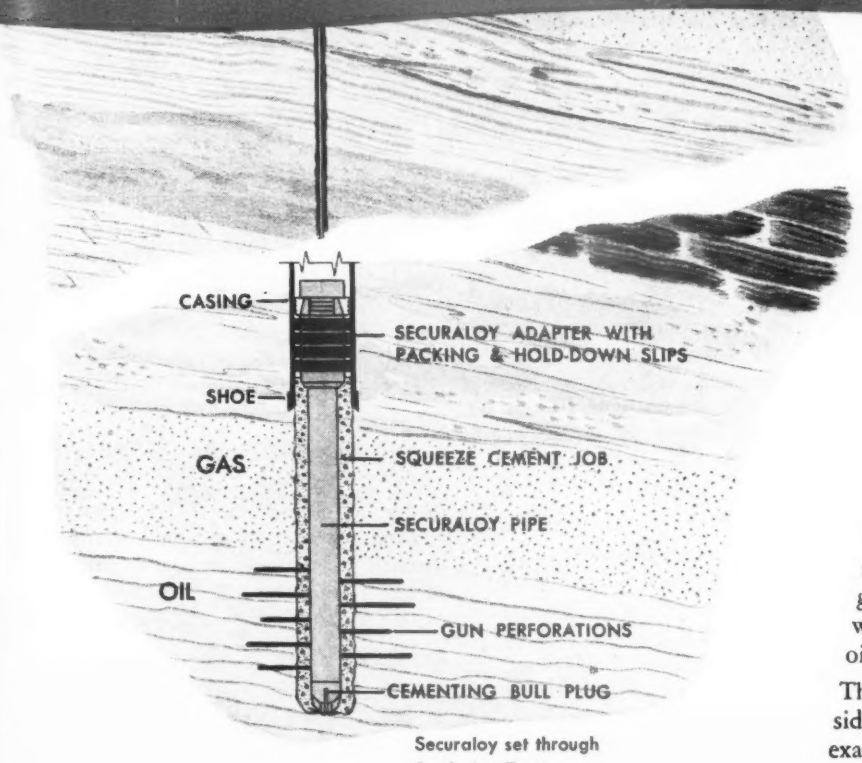
LOCATION: Texas

GAS-OIL RATIO: 300 to 1

PRODUCTION: 5-6 barrels per day on pump

QUESTION: How to increase production and lower gas-oil ratio by a simple and satisfactory remedial method

Too much gas—Too little oil?



Securaloy set through Producing Zone

When a Texas operator found his gas-oil ratio too high and production way down he determined that the positive way to correct this situation was to use Securaloy. You, too, can profit by using Securaloy to solve your gas-oil ratio problems.

This operator first tried a plastic squeeze job, but the well still made only 6 barrels per day. Then a cement squeeze job was performed, with the entire open hole left full of cement and then drilled out. This proved unsuccessful too!

Finally, the operator cemented Securaloy pipe through the gas-oil sands, as shown. Selective strata were gun perforated and acidized. The well was then completed for 80 barrels of oil per day with a 40 to 1 gas-oil ratio!

This same remedial method is now considered standard practice . . . Another example of the application of Securaloy to solve your production problems.

Security

ROCK BITS • CORING BITS • HOLE OPENERS • REAMERS • CASING SCRAPERS

Securaloy

PRODUCTION EQUIPMENT

SECURITY ENGINEERING CO., INC.

ONE OF THE DRESSER INDUSTRIES

Main Office and Plant: Whittier, California

Branches in all of the major producing areas

Export Office: Chanin Building, New York City

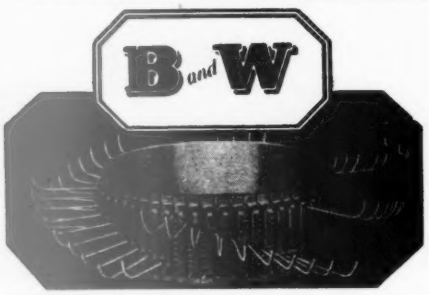
LINE SCALES

(Above) Super 500,000-lb. capacity, 14" dial. (Below) Packer Special, Capacity 40,000 lbs., 6" dial. 18 other models for every drilling, well servicing, or work-over need.

20 MODELS to choose from

With a LINE SCALE you know the pull on the line, and the weight on the bit in pounds. Repeated tests prove the accuracy and dependability of LINE SCALE readings under all working conditions . . . even in areas of rapid temperature changes.

LINE SCALE CO., Inc.
Box 4245 **Oklahoma City** Phone 6-1765
Gulf Coast Representative: Hiram Wheeler
Box 8043, Houston 4, Texas—J2-1107
Box 8043, Houston 4, Texas—J8-1107



PATENTED AND PATENTS PENDING

B & W Wall Cleaning Guides prevent channeling . . . . the greatest single cause of cementing failures.

DON'T SQUEEZE!

It Can Be Avoided.

BRUCE BARKIS — B and W INCORPORATED — KENNETH WRIGHT

Well Completion Specialists

HOUSTON, TEXAS • LONG BEACH, CALIF.

Falling Objects of the Two-Ton Type

Within the space of a few weeks, two similar drilling accidents occurred while pipe was being pulled from the hole. In each case the traveling block was allowed to pull into the crown, causing the drilling line to part and the block to fall. The block crashed to the derrick floor, destroying the floor, automatic slips, and other equipment.

To prevent future accidents of this nature, an automatic device is being developed that is similar in principle to indicators on ordinary building elevators. It shows the driller the height of the traveling block at all times and automatically shuts off power and stops block when it nears crown.

Saudi Arabia Output

Crude oil production in Saudi Arabia during October amounted to 14,530,550 bbl, or an average of 468,727 bbl per calendar day, it was announced by the Arabian American Oil Company.

Crude processed at the company's refinery at Ras Tanura amounted to 4,174,778 bbl, or an average of 134,670 bbl per calendar day.

Crude oil production for the first ten months of 1948 amounted to 113,941,500 bbl, an average of 373,579 bbl per calendar day. Crude run in the refinery for the same period was 37,687,724 bbl, an average of 123,566 bbl per calendar day.

New Ladish Distributor

The Ladish Company has recently announced the appointment of Vinson Supply Company, 220 N. Boston Street, Tulsa, Oklahoma, with branches at Dallas and Odessa, as authorized distributor for the Ladish "Controlled Quality" line of forged and seamless welding fittings.

Waste Prevention Orders

The Texas Railroad Commission has issued orders, effective December 1, requiring the operators of fifteen oil fields to cease wasting casinghead and residue gas. The fields involved have a daily allowable of some 390,000 bbl from 9375 wells; their combined flare gas is in excess of 300,000,000 cu ft daily. Eight of the fields with about 5600 of the wells have gas processing plants available with more than 88 per cent of the wells tied into these plants, yet their flare gas amounts to nearly 200,000,000 cu ft daily.

It was testified at the show cause hearing that there is now an ample market for flare gas. Operators have filed suits to enjoin enforcement of the shutdown orders.

The state has agreed to temporary injunctions in all fifteen fields, following the ruling of three district judges to this effect in the first four tests.

Fields involved are: South Ceasar, Bee county; Heyser, Calhoun county; Conroe, Montgomery county; Magnet-Withers and North Withers, Wharton county; Flour Bluff, Nueces county; Tijerina-Canales-Blucher, Jim Wells and Kleberg counties; La Gloria (all zones), Jim Wells and Brooks counties; Fullerton, Andrews county; Goldsmith, Ector county; Levelland, Hockley county; McElroy, Crane and Upton counties; Seminole, Gaines county; Slaughter, Cochran, Hockley, and Terry counties; Wasson, Gaines and Yoakum counties.

Foster field, Ector county, was originally included, but the shutdown order was lifted and at the operator's request the December allowable was reduced by 20 per cent to eliminate the flaring of five million cu ft of residue gas daily. Ernest O. Thompson, chairman of the Commission, stated that if a field's gas waste can be stopped by reducing the allowable that course would be allowed on request of the operators.

Saval Expansion Program

Saval, Inc., Los Angeles manufacturers of Shear-Seal control valves, announce that their production capacity will be doubled by an expansion program now under way. Two new buildings are under construction.

Rubber Vital Link

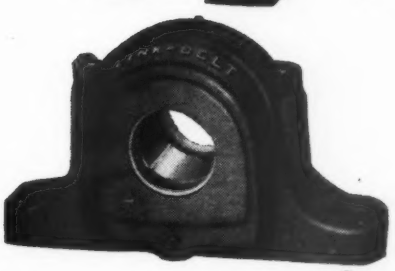
J. H. Hayden, vice president in charge of sales, Hewitt-Robins Incorporated, said the company's Hewitt Rubber Division is supplying seven different kinds of hose that oil men rely on to keep their operations going in the Gulf of Mexico where seven oil or gas producing wells have been discovered to date.

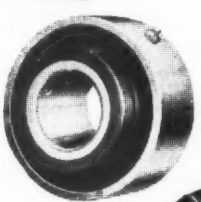
On a platform in the Gulf, oil men fuel their engines through oil-resistant Hewitt hose. They pump their washing and cleaning water through hose specially compounded to withstand pumping pressures and salt water corrosion. A special acid-resisting hose is used to "acidize" the hole.

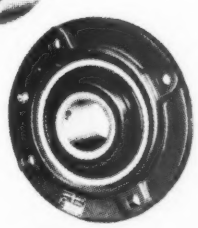
Hewitt oil well drilling hose is used, while suction and discharge hose is used to draw mud back to the storage pan. Two more kinds of Hewitt hose supply the men with water for cooking, dishwashing and for drinking.

WITH LINK-BELT BALL AND ROLLER BEARINGS *It's*

Operation "O.K."







Users everywhere are putting their big "O.K." on the operation of Link-Belt Ball and Roller Bearings. And they report smoother operation of machines equipped with these dependable, precision-built bearing units.

There's a complete line—mounted and unmounted—from which to choose the bearing to fit your job.

Our experienced engineers will be glad to help solve your bearing problems. Once you install Link-Belt Ball and Roller Bearings, you too will enthusiastically say, "Operation O.K.".

11.100

SEND FOR CATALOGS

LINK-BELT COMPANY

519 N. Holmes Ave.
Indianapolis 6, Indiana
Stocks in Principal Trading Areas

LINK-BELT BALL AND ROLLER BEARINGS

TYPE

DS

PEERLESS
Centrifugal
PUMPS

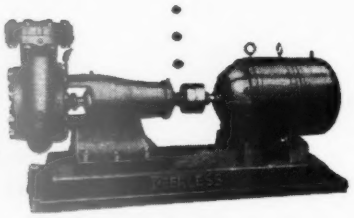
PROCESS SERVICES
ABRASIVE
AND CORROSIVE LIQUIDS

TYPE
DS
ENCLOSED IMPELLER

Application:
The Type DS pump is a general purpose process pump with enclosed impeller. Handles clear liquids in a variety of services and solutions which may be corrosive. Single-stage, single-end suction design. Capacities: up to 600 g.p.m.; heads up to 231 feet; temperatures up to 212 F. All types of drive.

TYPE
DSO
OPEN IMPELLER

Application:
The Type DSO pump has essentially the characteristics and applications as the Type DS. However, the Type DSO utilizes an open impeller with impeller vanes on back of shroud to permit pumping of fluids with solids in suspension, brines, sludges and the like. Capacities: to 1500 g.p.m.; heads: to 231 feet; temperatures up to 212 F. All types of drive.



Write for descriptive and illustrated Bulletin No. 803

fmc PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Indianapolis, Ind.; Los Angeles 31, Calif.
District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 No. Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, California; Los Angeles 31, California.

Hilker Joins Eastman

H. John Eastman, president of the Eastman Oil Well Survey Company, announces the appointment of Bud Hilker as director of public relations for the organization, with headquarters in Denver. Hilker was formerly a partner in Industrial News Service, and has had extensive experience in publicity and public relations work on the Pacific Coast and in the east.

Bud Hilker

H. E. Benson, formerly advertising manager for Eastman, has been named vice president of Eastco Import-Export Corporation, with offices in Denver, Colorado.

Appoints Allocation Body

The chairman of the National Petroleum Council, Walter S. Hallanan, has appointed 15 representatives of the petroleum industry to membership on the Regional Advisory Committee for District Four covering the Rocky Mountain States of Montana, Wyoming, Colorado, Utah and Idaho. The committee will function under the Voluntary Petroleum Allocation Plan recently approved under Public Law 395. It will be instrumental, in conjunction with local, state, and federal groups, in relieving any consumer hardships in the event such a situation should arise.

Appointments were approved by the Director of the Oil and Gas Division of the Department of the Interior.

M. H. Robineau, president of Frontier Refining Company, Cheyenne, Wyoming, has been designated chairman. Other members are: Charles Dodson, The Texas Company, Denver; Paul Hedges, National Congress of Gasoline Retailers, Salt Lake City; James Kessler, Diamond Gas and Fuel Company, Denver; L. L. Leabo, Bay Petroleum Corporation, Denver; Joe Lentz, Continental Oil Company, Denver; Fred J. Meine, Sinclair Oil Company, Denver; Henry D. Moyle, Wasatch Oil Company, Salt Lake City; Burton W. Musser, Utah Oil Refining Company, Salt Lake City; Glenn E. Nielson, Husky Refining Company, Cody, Wyoming; R. S. Shannon, Pioneer Oil Corporation, Denver; Branson Stevenson, Socony-Vacuum Oil Company, Inc., Great Falls, Montana; H. A. Stewart, Rocky Mountain Oil and Gas Association, Casper, Wyoming; C. M. Tuller, California Company, Denver; Ike Wescoat, Wescoat Oil Company, Boise, Idaho.

Dresser Wins Report Oscar

In the final ratings of an independent board of judges for the Financial World Annual Report Survey, Dresser Industries, Inc., Cleveland, Ohio, was judged as having the best 1947 annual report *for the fourth consecutive year*.

The bronze "Oscar of Industry" trophy will be presented to Dresser Industries, Inc., at the annual awards banquet in Hotel Pennsylvania in New York on October 21, 1948.

More than 4000 corporation annual reports were submitted in this national survey, the eighth in the series, and these were judged in one hundred industrial classifications for "Best of Industry" awards.

In the building equipment industry category, York Corporation, York, Pennsylvania, was runner-up for top honors, while Minneapolis-Honeywell Regulator Company, Minneapolis, Minnesota, took third place.

The jury who made the final selections was under the chairmanship of Dr. Lewis Haney, professor of economics at New York University. He was assisted by Dr. Glenn Griswold, publisher of Public Relations News; Sylvia F. Porter, financial editor of the New York Post; Elmer Walzer, United Press financial editor; and Lester Tichy, industrial designer, who served as art director.

Weston Smith, vice president of Financial World and originator of the annual report surveys, will present the "Oscar of Industry" trophies at the annual awards banquet, which will be attended by more than 1000 business leaders from all over the country.

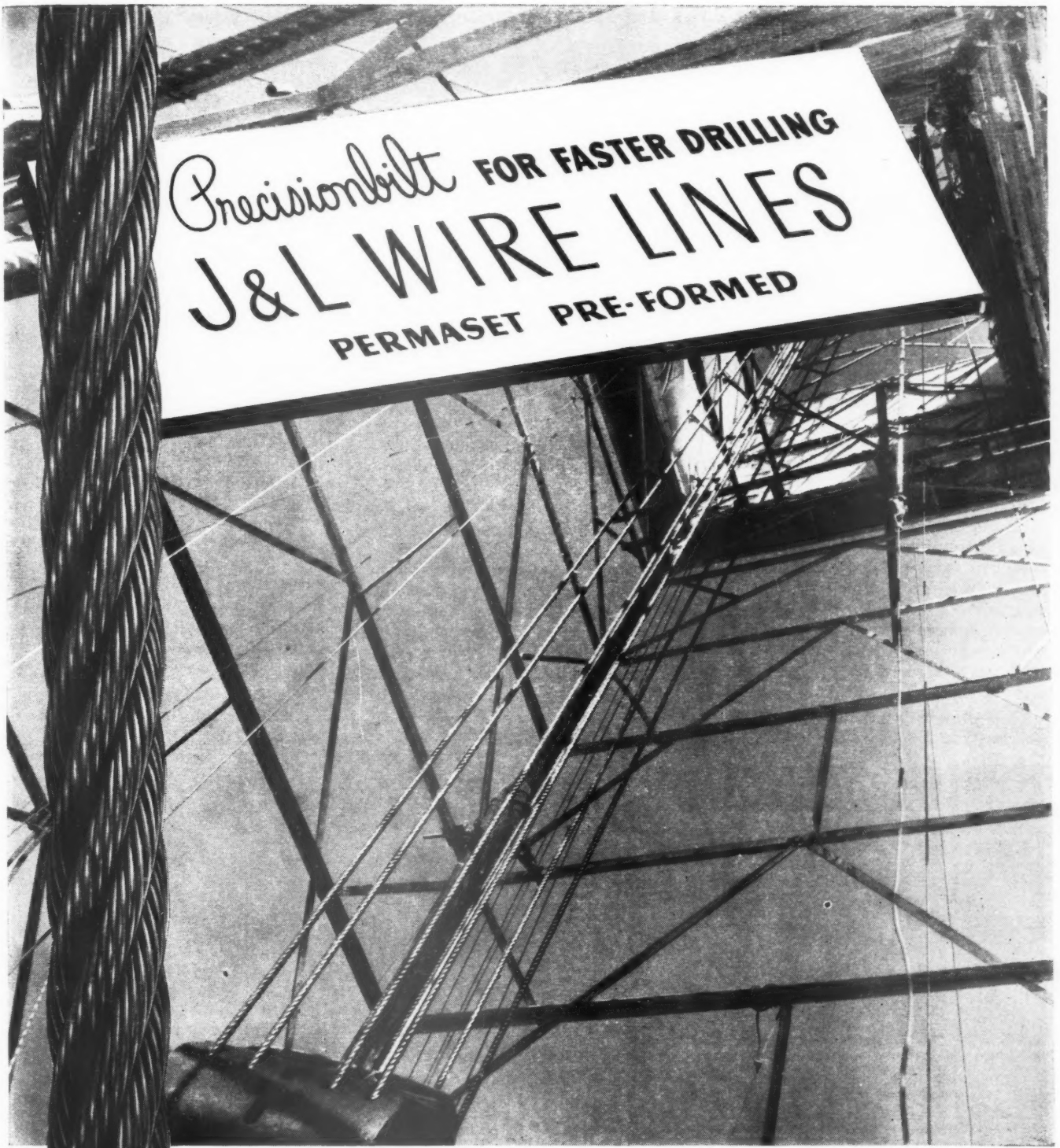
Make Trips

"Jack" Clemens, Martin-Decker Gulf Coast sales and service representative, with headquarters at Houston, Texas, recently vacationed in California and spent considerable time at Long Beach in the Martin-Decker plant.

"Jack" Clemens

"Mutt" Donovan

"Mutt" Donovan, Martin-Decker Mid-Continent sales and service representative, with headquarters at Oklahoma City, is on a business trip to the Rocky Mountains and Canada. "Ben" Hanly, Reed Roller Bit Company representative at Casper, Wyoming, is accompanying him to Calgary.



Drilling crews know that they can depend on J&L *Precisionbilt* Wire Rope. They know that it is uniform in diameter, strength, durability and fatigue resistance. The extra life they get from J&L *Precisionbilt* Wire Rope speeds up drilling—lessens the time lost for line replacement. It's economical to specify "J&L *Precisionbilt*" when you buy drilling lines.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

J&L *Precisionbilt* PERMASET PRE-FORMED WIRE ROPE

New Companies Organized

Lee Flood has announced the formation of two companion companies to serve the needs of the smaller producers of oil and gas in the Permian Basin. Flood, president and general manager of the new companies, will have headquarters in Midland, Texas. One of the concerns, Production Management Company called PROMCO, is designed to provide a complete, confidential managerial service to the small producer. The other company, Production Specialties Company or PROSCO, will be a medium through which badly needed specialized production equipment and services may be obtained.

Some of the specialized equipment and services to be offered by PROSCO are desulphurization units designed to sweeten small amounts of sour gas to be used as fuel; electronic instruments for the continuous and automatic measurement of the amount of water in oil; portable well-testing units; complete analyses of oil and gas; a line of specialized oilfield chemicals; and other highly specialized and unique equipment and services that may be developed from time to time.

The expressed object of PROMCO is to provide a means whereby owners of small, isolated producing properties may avail themselves of a greater degree of efficiency and economy in the operation of their properties than can be attained otherwise.

Lee Flood

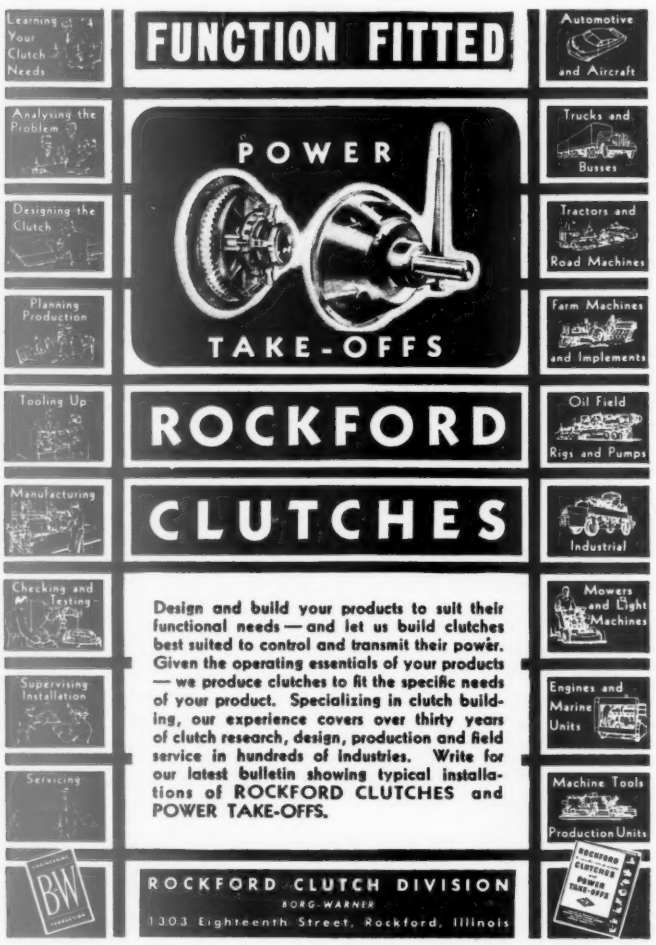
Since January 1, 1945, Flood has served as chief engineer of the Goldsmith Pool Engineering Committee in Midland. He will continue in that position until December 31 and may continue to serve the committee in an advisory capacity after that time. Flood has spent virtually an entire lifetime in the oil and gas industry, receiving his early training in one or another of the Henry L. Doherty companies. Leaving Natural Gas Pipeline Company of America in Chicago in 1939, he served as one of the editors of *The Petroleum Engineer* until shortly after Pearl Harbor, when he spent a year as a member of the production staff of PAW in Washington. In early 1943, he opened a branch office for Crane Packing Company, Chicago, leaving that company in Houston to go to West Texas. Flood was graduated as an engineer from Stanford in 1930.

Mobile "Carnival of Measurements" on Tour

With more than 9,000 miles of cross-country travel already behind it, General Electric's rolling "Carnival of Measurements" exhibit has embarked on a year-long, 14,000-mile tour of 80 major U. S. industrial centers.

Featuring "Instruments in Industry," the collection of more than 150 electrical measuring devices manufactured by the G-E Meter and Instrument Divisions, West Lynn, Massachusetts, will be displayed some 300 times in the next nine months to selected groups concerned with the science of measurement.

The complete exhibit consists of panels on which are displayed various electrical instruments of great interest.


Learning Your Clutch Needs
Analysing the Problem
Designing the Clutch
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FUNCTION FITTED
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Design and build your products to suit their functional needs — and let us build clutches best suited to control and transmit their power. Given the operating essentials of your products — we produce clutches to fit the specific needs of your product. Specializing in clutch building, our experience covers over thirty years of clutch research, design, production and field service in hundreds of industries. Write for our latest bulletin showing typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS.
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Built with still more guts than our Standard Model Self Loading Float, which is rated as 50,000 lbs. and regularly walks off with much more, these new, huskier models are rated at
75,000 LBS. – 100,000 LBS.
They are built to stand any test your common sense puts them to. You'll want to know more about these new huskies, built as only Hobbs builds Trailers.
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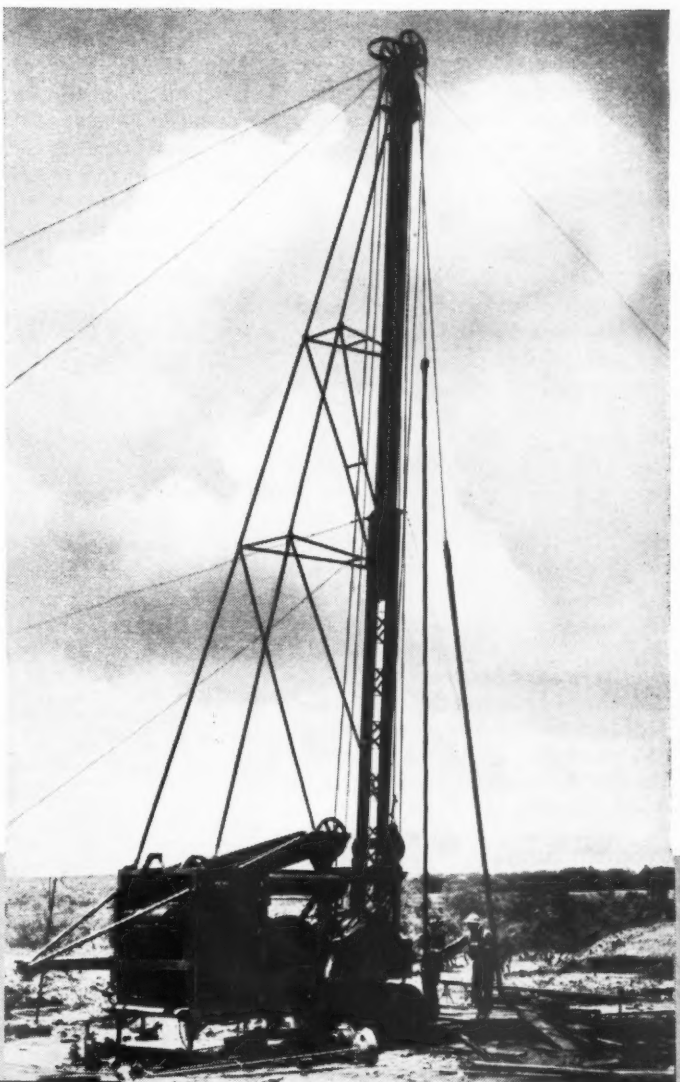
Bucyrus-Erie Versatility
Keeps You Busy Signing Contracts . . .

The ability of Bucyrus-Erie spudders to handle a great variety of oil-field operations — ranging from top-to-bottom drilling to such servicing jobs as pulling and setting tubing, rods, and casing; swabbing, cleaning out and developing — enables Bucyrus-Erie owners to line up and speedily complete contract after contract. Successful contractors know that Bucyrus-Erie spudders clean up work schedules in the shortest possible time. Why not let this field-proved versatility pay off for you?

Bucyrus-Erie Company, South Milwaukee, Wis.



Two forward speeds and a quick reverse on all drums permit fast handling of diversified servicing jobs. The 36-L shown drilling in after a rotary on a job near Albany, Texas. The rig is owned by the Jones Well Servicing Company of Abilene, Texas.

See for Yourself

Check with your nearest Bucyrus-Erie Spudder Distributor. He'll tell you where you can watch a Bucyrus-Erie Spudder in action.

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Beacon Supply Co.	Borger and Pampa, Texas.
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Great Northern Tool & Supply Co.	Billings, Kevin and Cut Bank, Mont.; Casper, Wyo.
Gross Supply Co.	El Dorado, Kan.
Hauco Supply Co.	Greensburg, Pa.
Iverson Supply Co.	Tulsa, Okla.; Odessa, Texas; Artesia, N. M.
The McJunkin Supply Co.	Charleston, W. Va.
Olympic Supply Co.	Seattle, Wash.
Randall-Zogg Supply Co.	Owensboro, Ky.
The Straker Supply	Mt. Pleasant, Mich.
Tillsonburg Pipe & Supply Co.	Tillsonburg, Ont.
Turner Valley Supply Co., Ltd.	Calgary, Alta.
Zanesville Tool & Supply Co.	Zanesville and Wooster, Ohio

EXPLORATION ACTIVITIES

North Florida Wildcat

Coastal Petroleum Company, affiliate of Pancoastal Oil Company, C. A., Venezuela, and Gulf Oil Corporation have begun a wildcat test near Wacissa, 20 miles east of Tallahassee, in Jefferson county. The well, No. 1 E. P. Larsh, is being drilled by Parker Drilling Company, Tulsa, Oklahoma. The contracted depth is 8500 ft, being some 2000 ft deeper than the only previous lower zone test of this general area made by Stanolind Oil and Gas Company's dry hole in 1947. Geologists anticipate the penetration of a thick section of oil prospective Eagle Ford-Woodbine sand and shale, similar to that in neighboring coastal states.

Deep Pool Opener

Gulf Oil Corporation has completed No. 1 Mainka NW NW NE 12-5-5w, deep pool opener in Grady county, Oklahoma, with production from the Tulip Creek sand between 13,137-13,-250 ft. On 24-hour test the well flowed 464 bbl of 46 gravity crude through 11/64-in. choke. It has been further choked to the temporary allowable of 400 bbl daily.

Ethiopian Survey

In an address to the Geological Society of America in New York City, Hall Taylor of Columbia University stated that possible oil pools may be found in eastern Ethiopia. His recent survey of the area indicates several thousand feet of sandstones, shales, limestones, and other strata favorable to the accumulation of oil. Emperor Haile Selassie has already granted a concession for petroleum exploration to the Sinclair Oil Corporation.

Oil Search in Mozambique

Mozambique-Gulf Oil Company, a wholly-owned subsidiary of the Gulf Oil Corporation, has been granted a concession for oil exploration and development over an area of 45,000 sq miles in Mozambique.

As no adequate maps of the area are available the first step in the search for oil is the preparation of aerial maps. For this purpose the Aero Service Corporation of Philadelphia began photographing the area at the end of July. The maps thus obtained will be used first as a guide for an airborne magnetometer survey and later for the oil company's development planning.

Exploration in Mexico

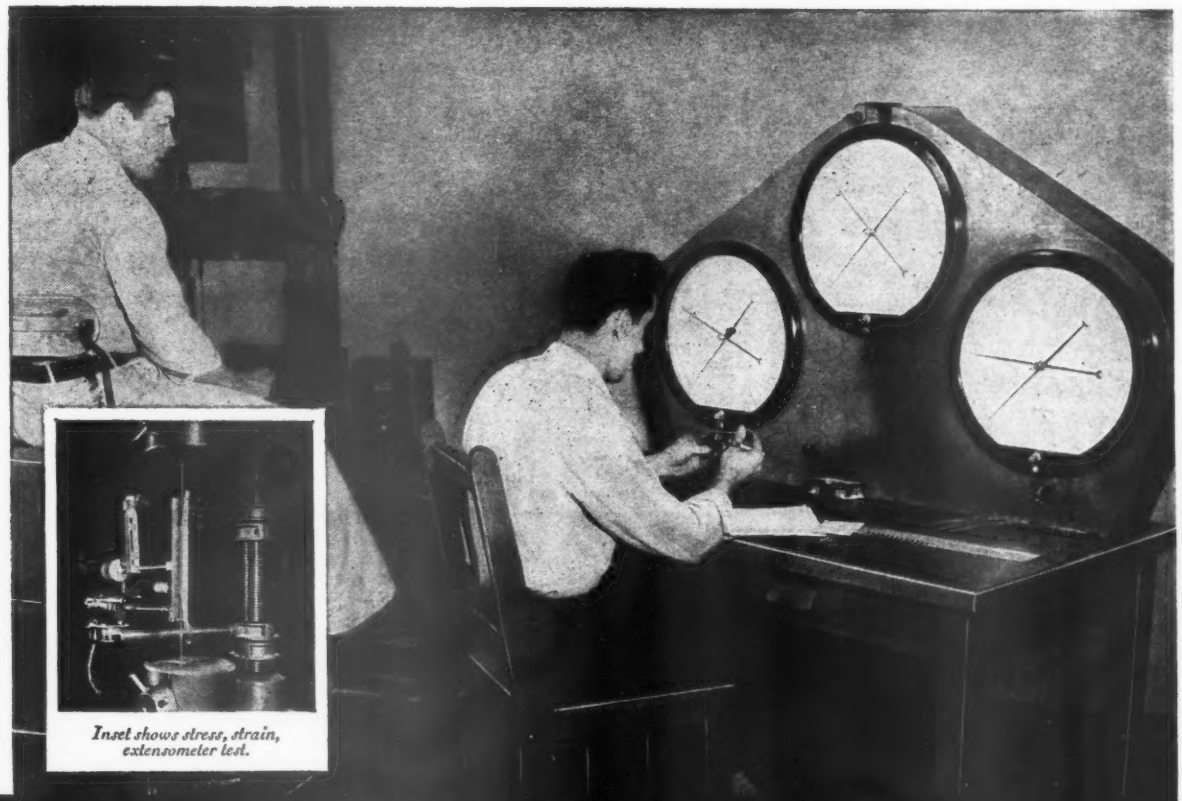
In its effort to meet the growing internal demands of Mexico as well as to place this nation in the role of an exporter, Petroleos Mexicanos will step up its search for oil in 1949 even above that in 1948. The United States is logically interested in these developments since the large refineries of the Gulf Coast have no more accessible outside source for oil.

It is anticipated that survey crews will develop locations for drilling 75 to 100 wildcats per year. Supplementing the geological-geophysical exploration and test wells of their own crews, Pemex officials have entered into contracts with U. S. organizations for specific projects. As an example, the agreement with Rhodes & Sullivan, Inc., of Abilene, Texas, commissions this concern to drill five locations in the Matamoros area of Northeastern Mexco with the prospects of more.

Tidelands Salt Dome

Humble Oil and Refining Company has discovered a salt dome eight miles off the Louisiana coast. The company's No. 1 State Pelican Island, block 30, off the Plaquemines parish shore, entered salt at about 3000 ft. Shows of oil and gas were picked up on an electric log from 2152 to 2185 ft.

Aerial Photo Study. *Before going on an "aerial reconnaissance" expedition in the field, Carter Oil Company geologists study aerial photos in the geological laboratory at Lander, Wyoming. Actual structures and outcrops will be located, and degree of dip and other information will be noted directly on the photography.*



Inset shows stress, strain, extensometer test.

How to Measure the Muscle in Rope Wire

Measuring the muscle—or tensile strength—of rope is one of many important tests used in grading Wickwire Rope. And the engineers who supervise these tests are tough taskmasters.

Before they release a single coil of wire to the Rope Mill, they take two samples from each end of every coil. These samples are gauged for size and roundness. Then the wire is subjected to the extensometer test, the tensile, torsion and elongation tests. Tolerances are even more exacting than those established by the industry; any wire not meeting the standards is rejected. Colored tags listing size, strength and other data are affixed to acceptable coils. These tags stay on the coils until they are made into wire rope—and the data they contain is kept on file for future reference.

This meticulous adherance to standards characterizes every phase of Wickwire Rope fabrication. Coupled with the services of Wickwire Distributors and Rope Engineers in specifying the rope with the right kind of muscle to do your hoisting or hauling job, it is your assurance of the utmost in performance, safety and long rope life. Wickwire Rope is available in all sizes and constructions, both regular lay and WISSCOLAY *Pre*formed. Next time you order wire rope make it Wickwire Rope. After checking its performance we feel certain that you'll keep on ordering it.

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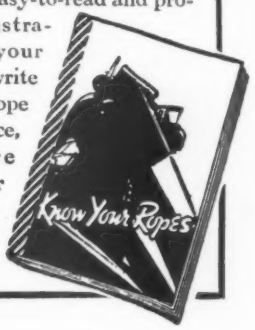

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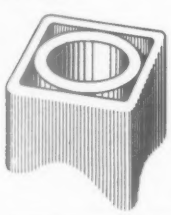

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Size	Overall Length	Bottom Connection	Top Connection	Size Opening
2½"	18½ ft. 21½ ft. 23½ ft.	2" A.P.I.—8 Rd. Thd. Upset	3" L.H. 8 Rd. Thd. Int. Upset Drill Pipe	1⅛"
3"	21½ ft. 23½ ft. 26½ ft. 36 ft.	2½" A.P.I.—8 Rd. Thd. Upset	3" L.H. 8 Rd. Thd. Int. Upset Drill Pipe	1¾"

For full information see 1948 Composite Catalog, page 1524, or write to

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General Co-Chairmen, *Raymond A. Stehr (left), chief geologist for Seaboard Oil Company and president of the Dallas Geological Society (AAPG affiliate), and W. W. "Ike" Newton, of The Geotechnical Corporation and president of the Dallas section of the Society of Exploration Geophysicists, presided over a very successful joint regional meeting of these organizations. Above (center) is Ronald K. DeFord, University of Texas professor of geology, who discussed reef limestone oil fields at the meeting.*

New Pay for Wyoming

Wyoming's first rich strike in the Mesa Verde formation was made during November by Pure Oil Company's No. 2 in C NW NW of 11-33n-84w, West Poison Spider field, Natrona county. The well, a direct offset to its No. 1, which was brought in last summer as the world's deepest producer at 14,309 ft, was scheduled to go a comparable depth but struck pay at 9230 ft.

W. M. Saxon of Billings, Rocky Mountain district manager for Pure, estimated the well flowed at the rate of 1600 bbl per day of 45 gravity crude. The well will be completed in the Mesa Verde, a formation that usually runs 800 to 1000 ft thick and often contains veins of coal. Previously, the only commercial production of oil from the Mesa Verde was in the small Quealy field in Albany county.

Humble Begins California Test

Humble Oil and Refining Company has made a location for its first well in the state of California. This will be a wildcat test known as the No. 1 DiGiorgio Fruit Corporation, located in the Delano area of Tulare County. This location is in the southern portion of the county roughly 30 miles northwest of Bakersfield in the San Joaquin Basin. The well will be projected to a depth of 7500 ft in the approximate center of a 13,000-acre block of leases acquired by the company during the past six months. The company has acquired several other wildcat blocks in California and plans to start drilling operations on two or three of these by the end of the year.

The Humble Oil & Refining and British-American companies are drilling a joint well which will be operated by British-American in the eastern end of the Ventura Basin near Castaic. Operations on this location have been commenced, and the well is projected to a depth of around 9000 ft. The drillsite is located on the Honor Prison Farm, owned by Los Angeles County.

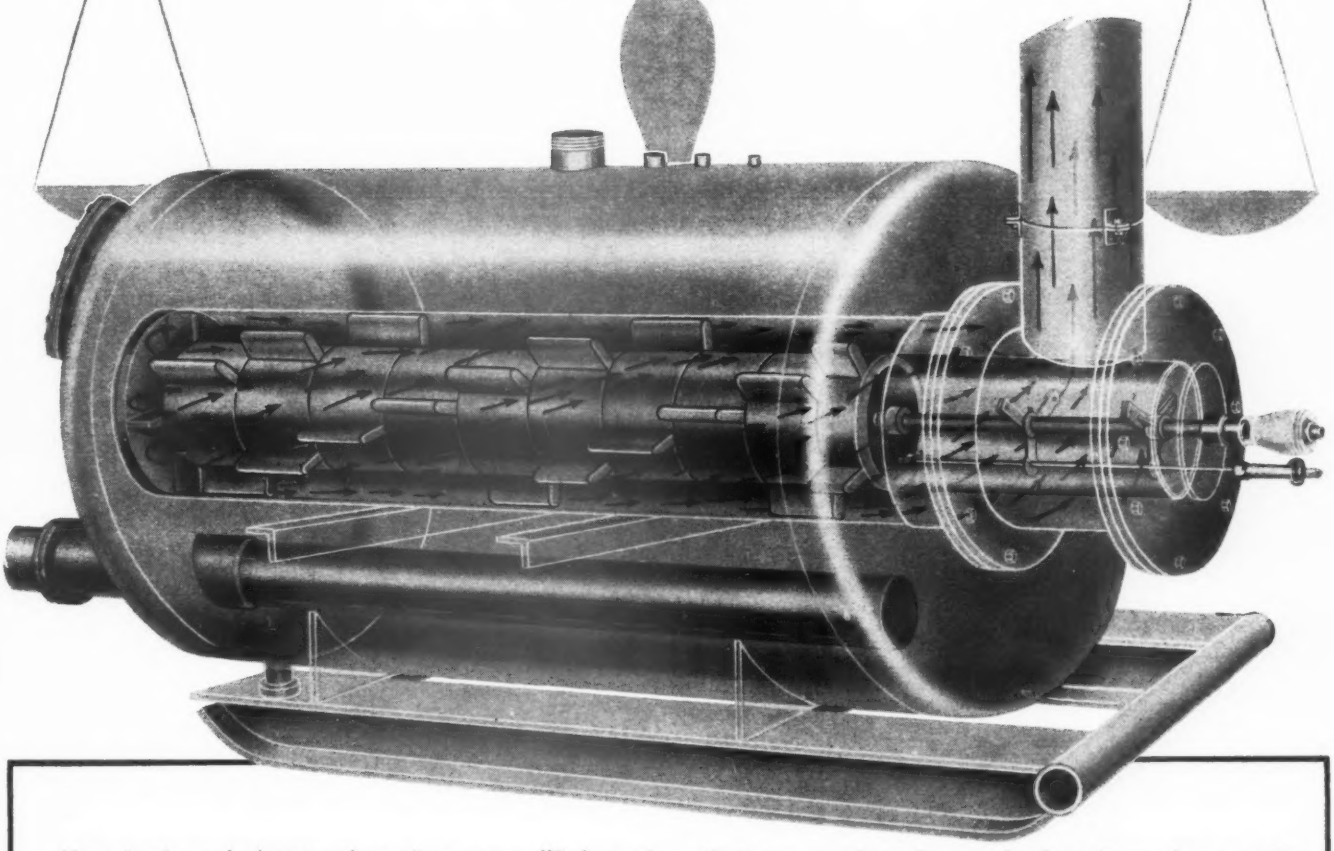
New Pay in Athens Pool

A new gas, distillate pay zone in the Vaughn sand of the Athens field, Clairborne parish, north Louisiana, was opened by the M. A. Halsey et al No. 1 Bishop-Lewis in 30-20-6w. On test the well made 10,500 MCF of gas on open flow and 33.6 bbl of 60 gravity distillate per MMCF. Perforations were from 8500 to 8544 ft, and bottom hole shut in pressure was 3756 psi. The deepest production at Athens heretofore had been around 6000 ft. The base of the Travis Peak at 7270 ft was also to be tested for a possible dual completion.

PARKERSBURG HORIZONTAL HEATERS

give you a Balanced Heat

THAT PUTS MORE OIL IN YOUR STORAGE TANKS



Here is the only heater that gives you a "Balanced Heat" . . . *because Parkersburg Horizontal Heaters are the only heater that combine radiation and convection heating principles to insure an even distribution of heat over the entire surface of the heating tube.*

This single exclusive Parkersburg feature eliminates a condition that has caused the failure of many ordinary type heaters.

Tests in actual service have proved time and time again that Parkersburg Horizontal Heaters . . . *the only heater with BALANCED HEAT* . . . have greater efficiency, produce less scale deposits and are easier to clean and service than almost any other type of similarly designed heater.

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OCS

PARKERSBURG

running tour with men in the industry

Edmond M. Wagner

Edmond M. Wagner, petroleum and mechanical engineer with Waldrip Engineering Company at Hollydale, California, was the recent recipient of the Presidential Citation "for outstanding contribution to the work of the office of Scientific Research and Development during World War II." For nearly 20 years Wagner has been identified with the petroleum industry, first in metallurgy and then in the mechanical and petroleum engineering fields, primarily concerned with hydraulic oil well pumps and related surface and subsurface equipment.

As Chief of the Engineering Office, National Defense Research Committee, he advised all development sections on technical matters relating to engineering design and production problems. At the end of the European war he became an active member of the Committee on Prosthetic Services of the National Research Council, charged by the Secretary of War with the development of artificial arms and legs for veterans. For Waldrip he supervises production of trailer-mounted and self-propelled drilling and servicing rigs, on which many of the patents carry his name as co-inventor.

Dr. A. B. Parsons, after eighteen years as secretary of the American Institute of Mining and Metallurgical Engineers, has resigned. The resignation becomes effective in February, 1949; but, in the meantime, Dr. Parsons will be on leave of absence. E. H. Robie, who has been Dr. Parsons' principal assistant during nearly all of his tenure of office, will be acting secretary during the remainder of 1948.

T. Spencer Shore was elected president of The Eagle-Picher Company by its board of directors effective January 1, 1949. **Joel M. Bowlby,** present president, becomes chairman of the board, to continue as general manager of operations and chief executive officer. **Joseph Hummel, Jr.,** with Eagle-Picher for 57 years, retired as board chairman, and was appointed honorary chairman. **Elmer Isern,** formerly vice president of Eagle-Picher, was made its president, with Bowlby assuming the board chairmanship.

F. C. Fellingham has been named assistant administrative coordinator for Stanolind Oil and Gas Company, announced V. E. Liles, administrative coordinator and director, announced.

Fellingham has been acting administrative coordinator for the past several months during Liles' absence. Prior to that, he was assistant manager of industrial relations for five years.

Fellingham received a BA degree from Dartmouth College and a law degree from the University of Tulsa Law School. He joined the Dixie Oil Company as a magnetometer operator, later becoming a landman. When Stanolind acquired the Dixie Company in 1931, Fellingham became a landman for Stanolind. He later became district landman, division landman, head of the title survey department and in 1943, assistant manager of industrial relations.

T. M. Smith, Jr. has been promoted to manager of field sales and service for Patterson-Ballagh Division of Byron Jackson Company for the Texas Gulf Coast. Ralph Snowden at Alice, Texas, and A. C. "Tag" Colgin at Houston will be under Smith. "Tag" will be transferred to Houston from Shreveport, Louisiana.

Joe L. Comer has been appointed vice president in charge of sales in the New York area for The Wm. Powell Company, with offices in New York City. Comer was for many years with the Crane Company. In 1943 he joined Culbert Pipe and Fittings as vice president of the firm.

Joe L. Comer

A. Joseph Mestier, Jr., has been assigned to Allis-Chalmers New York district office as petroleum sales representative, according to an announcement by J. L. Singleton, vice president and director of sales of the company's general machinery division.

A petroleum geology graduate of Massachusetts Institute of Technology, Mestier joined Allis-Chalmers in 1946 following his discharge from the U. S. Army as a captain. Previous to entering MIT, he was employed for a year and a half by the British Union Oil Company in his native Barbados, British West Indies.

Charles C. Whittelsey, has been elected vice president in charge of construction activities of Ford, Bacon & Davis, engineers-constructors. He has been with the firm since 1925 and was elected a director in 1946.

Whittelsey also has been elected executive vice president of the firm's subsidiary, Ford, Bacon & Davis Construction Corporation, with headquarters at Monroe, Louisiana. He has had charge of the engineering and construction of many large scale projects for his firm in the South. He was born in Birmingham, Alabama, and attended Washington University in St. Louis and Missouri School of Mines.

P. N. Kuzmich, 1948 graduate of the University of Pittsburgh in petroleum engineering, has been appointed corrosion engineer with Manufacturer's Light and Heat Company.

G. L. Holt has been appointed assistant district manager of the Madison, Illinois, plant of American Car and Foundry Company.

A native of Valparaiso, Indiana, Holt was in the mechanical department of Fruit Growers Express for nine years. In 1941 he became production engineer for the Indiana Steel Products at Valparaiso and from 1944 until joining ACF was plant manager of the International Railway Car and Equipment Manufacturing Company at Kenton, Ohio.

R. M. Hoel, sales agent for ACF, has been transferred from the Pittsburgh to the New York district office. In his new position he will represent ACF in the northeastern railroad area.

Hoel is a graduate of the business school of the University of Pittsburgh, and did postgraduate work at Iowa State University. He has been in the sales department of ACF since 1946.

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GUN PERFORATOR SERVICE

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9. **EXPERIENCED MEN.** With years of experience behind them, thoroughly-trained McCullough gun-perforating crews do their jobs quickly, efficiently, safely.

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MONTANA: Cut Bank
LOUISIANA: Houma, Lake Charles, New Iberia, Shreveport
WYOMING: Casper

EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

▸ **J. P. Evans, Jr.,** independent operator of Jackson, Mississippi, has been elected president of the Mississippi-Alabama division of the Mid-Continent Oil and Gas Association, succeeding W. M. Vaughey. E. B. McGehee is general vice president, and E. D. Kenna was re-elected executive vice president. James L. Duffy, of Grove Hill, was chosen vice president for Alabama.

▸ **W. A. Maley** was made manager of the exploration department of Humble Oil and Refining Company: **J. Ben Casey** was named chief geologist; **Ed J. Hamner** was appointed California exploration manager; and **Douglas E. Bell** was promoted to head production geologist. This announcement was made by Hines H. Baker, president.

▸ **R. V. Gerner,** superintendent with Phillips Petroleum, has been transferred from Oklahoma City to Wichita, Kansas.

▸ **Charles E. Edwards** has moved up from East Texas, where he was district representative, to take over the managership of Kobe's Oklahoma district. He replaces **J. T. Lewis,** who has been assigned to West Texas. Edwards has been with Kobe since 1939,

Charles E. Edwards

joining the company at Oklahoma City. For the past three years he has been in East Texas, with headquarters at Longview.

Ralph N. Nelson, a newcomer to Kobe, has been appointed senior district representative in Brookhaven, Mississippi. He is a graduate engineer and served in both Europe and South Pacific in the Naval Air Corps.

Donald B. Ross, a Georgia Tech graduate and former Navy man, has been transferred from Kobe's Mid-continent Technical Service Section to the General Technical Service Division at Huntington Park. He will assist in promotional work being done by the division.

▸ **L. D. Simmons,** partner in the Laughlin-Simmons Company of Tulsa, has been elected to the board of directors of the Seismograph Service Corporation. Simmons served in the geological department of Carter Oil Company before organizing a well elevation service with Roland W. Laughlin in 1926.

▸ **James F. Blackwell,** who has been with The Texas Company 12 years, has been promoted to assistant division manager, Rocky Mountain Division, Producing Department of the company. Blackwell, a native of Fort Worth, has been division superintendent-drilling and production in the Rocky Mountain Division since April 1, 1947.

After his graduation from the University of Oklahoma with the B.S. degree in petroleum engineering, he worked for the Standard Oil Company of Venezuela as a petroleum engineer from 1933 to 1936. In October of 1936 Blackwell was employed by The Texas Company as a junior petroleum engineer at Seminole, Oklahoma. He advanced steadily to division petroleum engineer, Tulsa, in November, 1941. Following a military leave of more than three years, he returned to Texaco as division petroleum engineer of the Rocky Mountain Division, December, 1945. Last year he was promoted to division superintendent-drilling and production.

S. T. McCardell, a native of Franklin, Louisiana, and a 1933 graduate of Louisiana State University, has been promoted to division superintendent-drilling and production, Louisiana Division, Producing Department, The Texas Company, effective immediately, it was announced by E. R. Filley, manager, Producing Department at Houston and R. L. Keyes, manager, Louisiana Division at New Orleans.

McCardell started with the company 15 years ago as a rotary rig helper. He has been division petroleum engineer, New Orleans, since September, 1945.

J. A. Battle, Jr., assistant division petroleum engineer, has been advanced to division petroleum engineer, succeeding McCardell.

Battle, who was born in Palmyra, Tennessee, was graduated from the University of Texas with the B.S. degree in petroleum engineering and immediately started to work for The Texas Company in June, 1928, as a roustabout at Houma, Louisiana. He spent a year in north Louisiana area as a junior petroleum engineer. In 1941 he was transferred to the Louisiana Division office as a petroleum engineer and in 1945 was named assistant division petroleum engineer.

▸ **Warren Miller** has been appointed a division manager of Mud Products, Inc. of Tulsa. According to E. R. Albert, Jr., general manager of Mud Products, Miller will represent the mud sales and mud handling equipment division of the company in Kansas, Colorado, and the Panhandle

Warren Miller

area, with headquarters in Great Bend, Kansas. All equipment will be handled through the supply stores. Miller will also be available to drilling contractors and oil companies as consultant on mud-handling equipment problems.

Before joining the Tulsa organization, Miller had been vice president and partner of the Black Supply Company of Wichita, Kansas, since 1945. He began his supply career in 1925 with National Supply Company, serving with this organization until 1932 when he joined Bovaird Supply.

A. Allen Weymouth, well known for his work as a petroleum geologist in Venezuela, New Zealand, and the Middle East, has been appointed chief geologist of American Independent Oil Company of San Francisco. This announcement was made by the president of the newly incorporated company, **Ralph K. Davies,** formerly deputy petroleum administrator for war. Weymouth will serve as an executive assistant and consultant to **Nate P. Isenberger,** formerly of Phillips Petroleum Company, and now vice president of American Independent in charge of foreign exploration. Weymouth comes to this company from two and one-half years as development geologist for Standard Oil Company of Texas with headquarters in Houston. Other important past experience includes two years as chief geologist in Venezuela for Richmond Exploration Company, five years as senior geologist in New Zealand for New Zealand Petroleum Company, and three years as resident geologist at Bahrein Island for Bahrein Petroleum.

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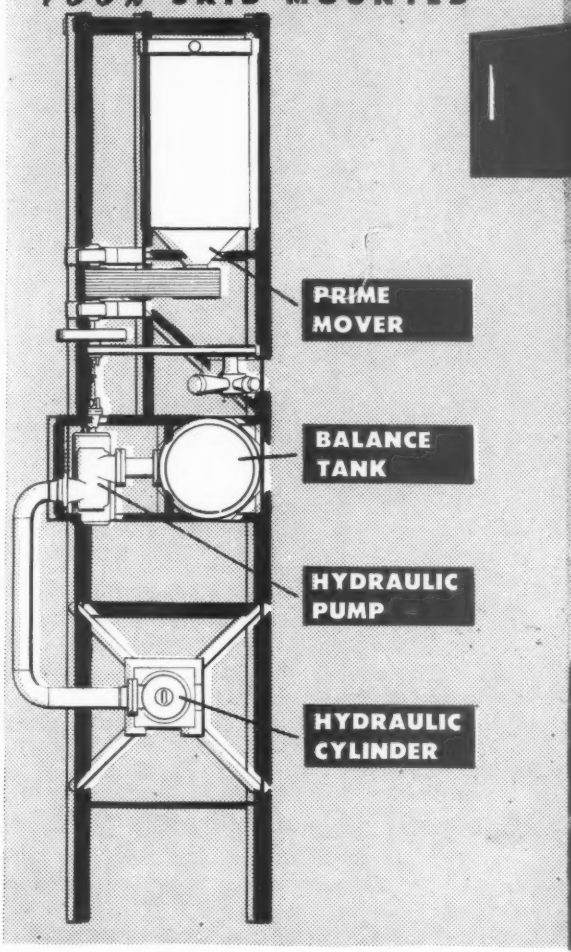
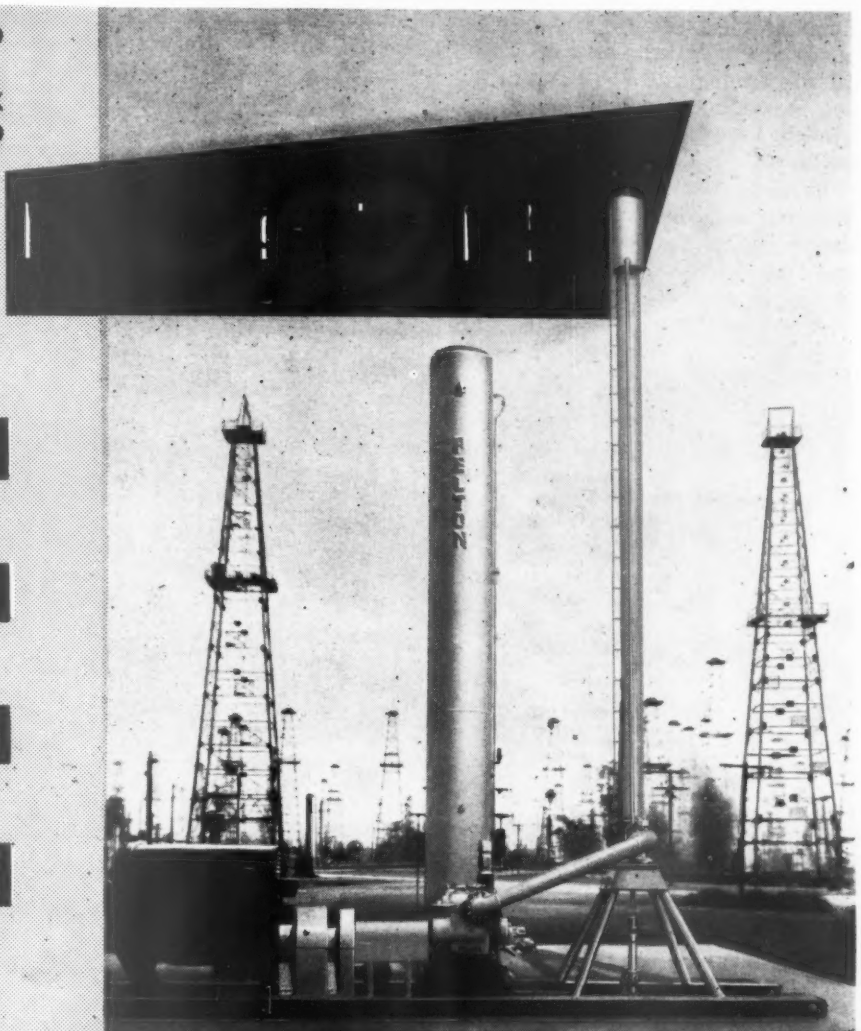
A COMPLETELY UNITIZED
Long Stroke
HYDRAULIC PUMPING JACK
***100%* SKID MOUNTED**





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All Series A and Series A-P utilize a positive displacement pump and a full hydraulic stroke reversal control. This combination adds up to HIGH EFFICIENCY and SOFT ROD REVERSALS.

Whether your pumping depth is 2,000 feet or 12,000 feet, PELTON Engineers have facts and figures to prove how a PELTON can increase production—decrease costs. Write for Bulletin No. 38.

UNITIZED DESIGN • SIMPLIFIED CONTROLS • CLEAN INSTALLATION

The PELTON A-P, which is completely skid mounted, complements the Standard Series A, in which the pump group and the prime mover are located any desired distance from the well, and the hydraulic cylinder is mounted at any desired height above the well. However, both the Series A and A-P incorporate new simplified operating controls, utilizing but two operating valves.

In the A-P design, the *complete jack*, including the prime mover, balance tank, hydraulic pump and the hydraulic cylinder, is mounted on a single portable skid. As a result, *only one connection*, the gas line to the prime mover, is broken to move the jack on or off the well. The A-P design also makes it possible to work on the well *without breaking the hydraulic circuit* of the jack.

Series A and A-P Jacks are available in a *20 foot stroke length* and polished rod load ratings of 20,000 lbs., 26,500 lbs. and 35,000 lbs.

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▸ **Francis R. Wheeler,** formerly petroleum engineer with Engineering Laboratories, Inc., of Tulsa, Oklahoma, has joined the staff of Chemical and Geological Laboratories, Casper, Wyoming, as director of the expanded Petroleum Engineering Department.

▸ **Fred C. Beleau** has been named division drilling superintendent at Casper, Wyoming, for Stanolind Oil and Gas Company it was announced by J. F. Cullen, Rocky Mountain division manager. This position is newly-created in the Rocky Mountain division organization.

Beleau has been with Stanolind since 1933. His experience with Wyoming oil dates back to 1922, when he joined Midwest Refining Company. He remained with this company for ten years, maintaining headquarters at Salt Creek during most of this time. In 1935 Beleau was made a field superintendent for Stanolind in the Texas-Louisiana Gulf Coast division. He became a district superintendent in this division during 1941 and served in that capacity until the present.

▸ **E. K. Almond,** superintendent with Warren Petroleum at Maud, has moved to Fairbanks, Texas.

Hubert E. Bale

▸ **Hubert E. Bale,** Oklahoma City geologist-engineer, was a recent speaker at a joint meeting of the Society of Geological Engineers, the Pick and Hammer club, and Sigma Gamma Epsilon. The meeting was held at the Engineering Auditorium of Oklahoma University. Bale's subject was "Valuation of Oil and Gas Lands."

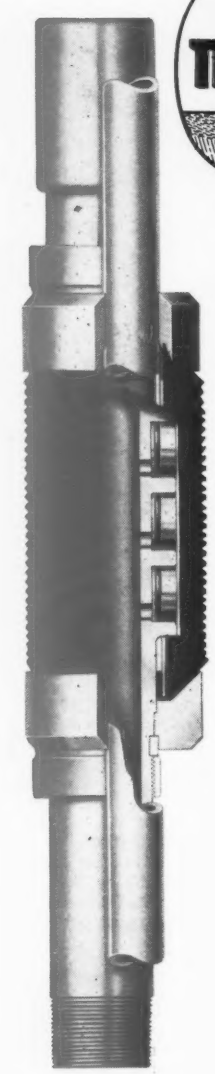
▸ **J. W. Pittman,** has been promoted to general superintendent of the area production division for Shell Oil Company. Also added to the area staff were **G. Stewart** as area reservoir engineer and **J. W. Watson** as subsurface engineer.

The new production divisions are at Franklin for supervision of south Louisiana and Donaldsonville for the southeast area of the state. The Lake Charles division office will supervise the remaining territory in west and north Louisiana. Division managers are: **W. C. Gorden,** Franklin division; **H. F. Winham,** Donaldsonville division; and **W. E. Owen,** successor to Pittman, in the Lake Charles division.

▸ **John W. Pew** has been appointed district manager of the Houston, Texas, office of Hewitt Rubber Division, Hewitt-Robins Incorporated. Pew will be assisted in his new post by Don Burge, recently named a Hewitt sales representative.

▸ **John H. Maxson,** formerly district manager of the Rocky Mountain division for Bay Petroleum Corporation of Denver, Colorado, has joined Anderson-Prichard Oil Corporation in a similar capacity. The new Apco district office in Denver will supervise activities in the Colorado-Wyoming area. For the past five months Maxson had been consultant for Apco in Denver.

▸ **Clark Lloyd,** director of production for the Texas Railroad Commission, is to succeed **Jack Baumel** as chief engineer of the commission, when Baumel leaves for Venezuela.



PAGE TYPE "C" TUBING ANCHOR

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NOTE

SMOOTH OUT YOUR TUBING TROUBLES with this PAGE TYPE "C" TUBING ANCHOR . . .

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The Page Type "C" Tubing Anchor is designed specifically to anchor parallel strings in "Free Pump" installations. Its advantages to operators are many. The Page Type "C" Anchor *assures* a fast tubing run-in without danger of accidentally setting slips, *eliminates* the human element of top-hole manipulation in setting and *saves* valuable time in landing tubing strings. The Page Type "C" *relieves* tubing of fluid and working pressure loads and *increases* the factor of safety in long tubing strings. It enables running longer strings of second grade tubing because the Type "C" *supports* the tubing and holds it in tension, free of "working" loads.

SIMPLE OPERATION

The Page Type "C" Tubing Anchor sets hydraulically on fluid pressure differential. The hydrostatic head of oil in the power string together with the "free pump" surface operating pressure, forces a series of small pistons against v-cut slip segments that grip securely against the casing. Holding power of the slips far exceeds fluid head and operating pressure loads. Release and removal from well requires only drainage of tubing. Tool can be run-in either end up.

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Anchor Body made from a solid billet of steel . . . working force consists of two v-cut slips and six pressure-sealed pistons . . . all parts replaceable and interchangeable.

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1. Mission's method of sealing between the valve seat and the valve body has been proved through the years to be superior.

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3. The Mission Super-Service Valve does not have the interchangeable wear-taking bushing that is such a popular feature of the Mission Silver Top Valve. Instead it has four cross arms which function both as a striking surface and for distributing the load. It has a longer valve stem to reduce valve "wobble".

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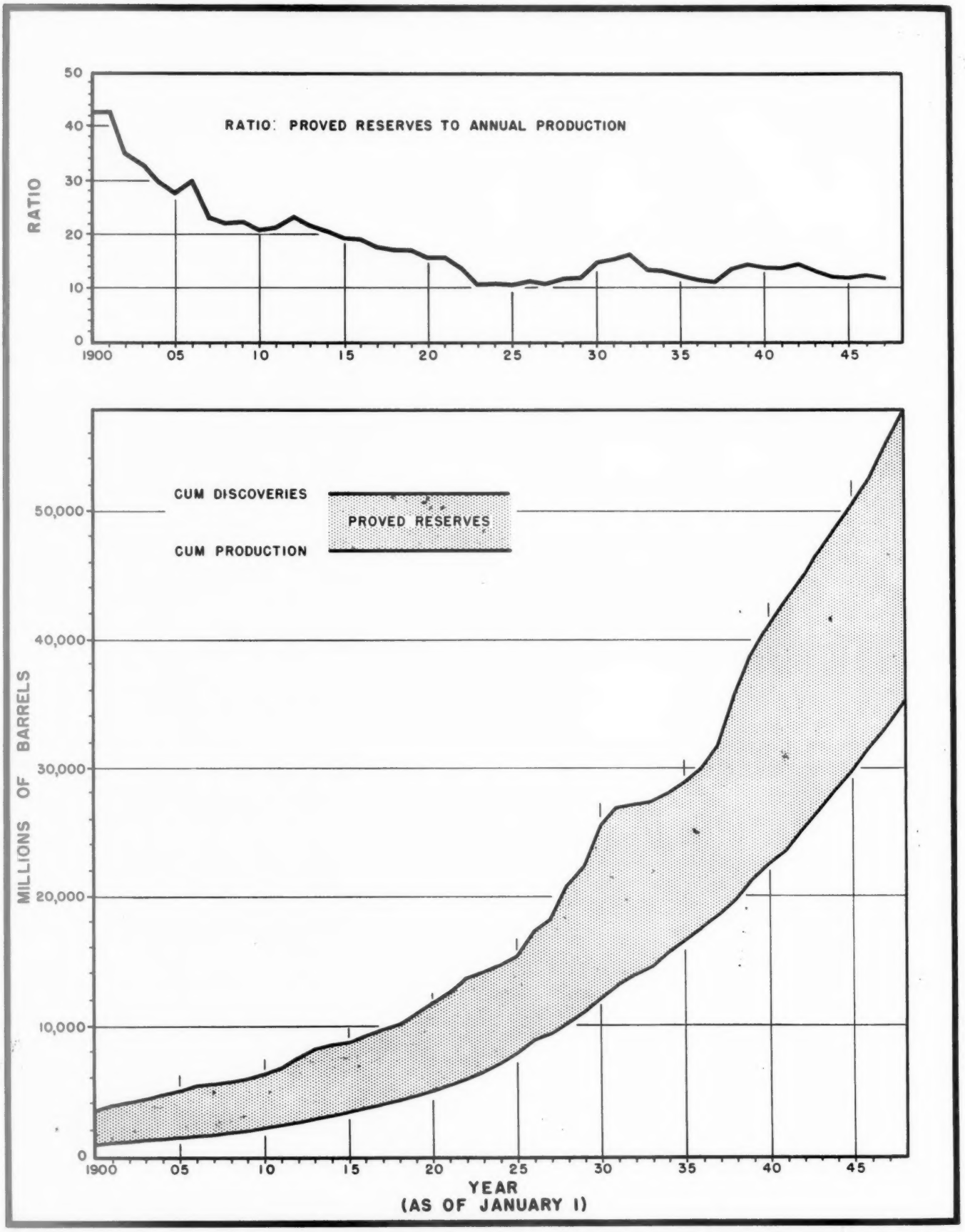
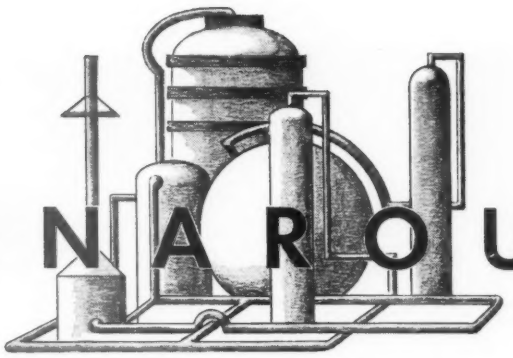
Ratio of discoveries to production has been maintained above 10.4 to 1 over the last 24 years



From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

THE TURNAROUND



What Is Our 'Refining Capacity'?

WITH unprecedented demand for petroleum products increasing, with actual or potential shortages of these products in various localities of high population concentrations, and with vote-conscious legislators watching the oil industry closely, the problems of determining how much refining capacity we actually have, and how much we need assumes more than statistical importance. How much capacity do we need and, by direct inference, how much more should be built in the near future to meet requirements?

How much of any threatened or feared shortage of products is due to inadequate capacity, and how much is due to lack of sufficient transportation capacity in affected areas? With refining construction costs up to more than twice the prewar figures, according to several authorities, it behooves the industry to build no capacity now which can be postponed until more balanced times are here.

As of mid-1948 Fred. Van Covern, API, at the request of National Petroleum Council's Committee on Refining Capacity, estimated the capacity figures for June 30, 1948 and December 31, 1948. This estimate credited 5,845,000-bbl capacity for June 30, an increase of less than ½ of one per cent above the December, 1947, estimate. As of the end of 1948 the same estimate is 5,919,000 bbl of crude per average day, or about 1½ per cent greater than that for June.

As of November 13, average daily crude runs to stills as shown by API figures credit 5,712,000 bbl per day during the week. This rate is a good 96½ per cent of the estimated capacity at year's end, a high percentage when viewed in the light of the 92 per cent operating a year ago. Refinery statistics indicate a strong stockpiling by the industry against any shortages this winter.

The Committee finds that the refining capacity curve "must flatten off from now on." It is known that much of this reported capacity falls in the category of marginal returns because of poor economics of operation. When either price or demand or both drop, how soon must a considerable proportion of this borderline capacity shut down because of red figures?

Automotive builders who are pulling their punches on motor fuel anti-knock requirements, are merely giving a respite, with higher compression pressures in the near offing. Rumor says that in some new car engines the projected 7.5 and higher compression ratios will be eased off to enable the operator to use motor fuels now generally available, but no indication is given that the engines will be redesigned for these lower rating fuels. When refining capacity and market demand are adjusted so that the motor fuel market becomes buyer's rather than a seller's market, it has always been the case that fuel quality is upped to improve selling inducements. This inevitably will force older, less efficient refining capacity to the wall because of inability to meet quality requirements within cost limits.

The statement of the Committee that "refinery capacity is likely to be a serious bottleneck" until sometime in 1949, if the excessive demand continues appears to be warranted by the facts. Any serious lessening of demand will pinch uneconomic capacity between the jaws of lowered price and increased quality demands in a buyer's market.

Arch L. Foster

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Note simplicity of controls. Also note the sloping panel that permits easy readability of scales from both sitting and standing positions.

ADVANCED FEATURES DESIGNED INTO THE MODEL "B" INCLUDE...

CONVENIENCE:

Direct reading wavelength scale . . . 320 to 1000 millimicrons . . . readings reproducible to great accuracy.

Direct reading transmission and absorbance (optical density) scales on large easily-read meter.

Continuously variable slits for smooth, precise settings.

4-Position sensitivity multiplier permits readings to be made on most advantageous portion of scale.

Four position cell carriage permits quick positioning of any of 4 cells by an external control.

ACCURACY:

Photometric accuracy to 0.5% transmission or 1% absorbance.

Negligible stray light—less than 1½% at 320 millimicrons.

Resolution—permits less than 5 millimicron spectral band width over most of spectral range.

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Liquid, solid and gaseous samples may be analyzed.

Monochromatic light beam is easily brought outside the instrument for long path measurements and special uses.

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Interchangeable photocells—red or blue-sensitive to utilize the high resolving power of the Model "B".

Easily-attached Model "B" accessories are available for special types of measurements and for added convenience and accuracy. Write for details.

The new Model "B" Spectrophotometer is by far the outstanding routine instrument available. It provides advancements pioneered in the Beckman Quartz and Infrared Spectrophotometers but never before offered in a low priced instrument. These advantages are important because they combine simplicity, convenience and versatility without sacrificing accuracy and reliability.

The Model "B" has better ultraviolet performance . . . better resolution . . . better wavelength and photometric accuracy . . . and more freedom from stray light than any other instrument in its field.

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Hydrocarbon absorption and fractionation process design methods

Part 17. Fluidynamics of Bubble Plate Columns

By WAYNE C. EDMISTER
Carnegie Institute of Technology

METHODS of making the theoretical plate and component distribution calculations have been presented and illustrated in the previous installments of this series, for both absorption and fractionation. After finding the number of equilibrium stages, the reflux ratio and the complete component distribution for a given separation, the designer must determine the number and type of bubble trays and the plate spacing and column diameter.

This part of the design involves considerations of fluid flow and the interphase transfer of heat and material. The fluidynamics of bubble plate columns will be discussed in this chapter. Plate efficiency will be discussed in the following installment. Allowable vapor velocities, entrainment, and tower flooding are topics of interest in the study of both subjects.

In most all commercial absorption and fractionation columns, bubble cap trays or decks are used to obtain the required vapor-to-liquid contact. As the name indicates, this contacting is accomplished by bubbling vapor through liquid. In addition to an interchange of components between the two phases, there is a transfer of heat from the vapor to the liquid.

The efficiency of a bubble plate as a contacting device depends, among other things, upon the intimacy of vapor and liquid mixing. Thorough mixing is obtained by taking a pressure drop across the plate. The efficiency of a bubble plate column may be reduced appreciably by the entrainment of liquid droplets from one plate to the next by high velocity vapor. To avoid excessive entrainment, the vapor velocity may be reduced or mist extraction devices may be installed between the plates. Thus, an entrainment will affect either or both capacity and efficiency.

In this way bubble plate efficiency and capacity are related. The designer of a fractionator or an absorber must, therefore, consider the hydraulics or fluidynamics of the column in estimating the plate efficiency as well as in calculating the pressure drop and determining the column diameter.

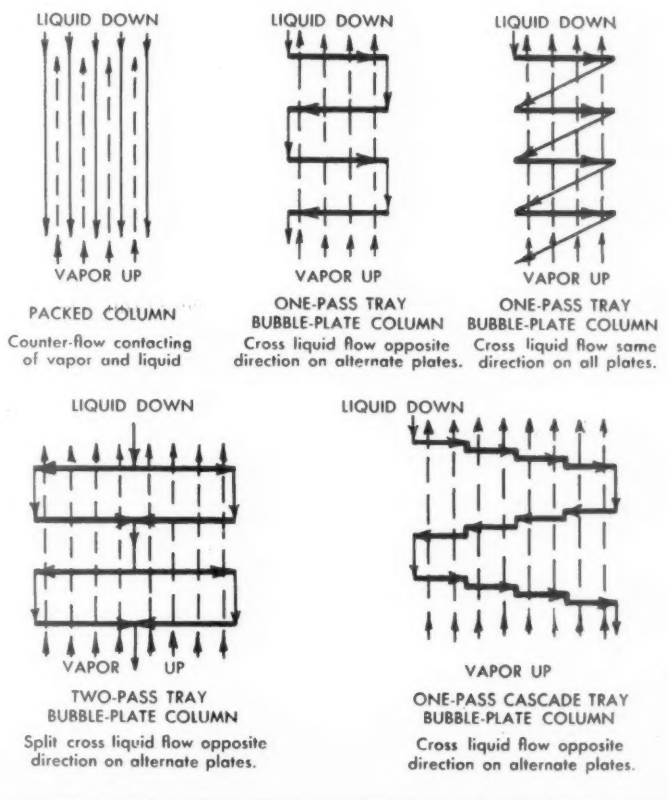
For the design of the column and its plates, to carry out a given separation, it is necessary to have experimental results on laboratory or commercial units, on which bubble plate efficiencies, pressure drops and hydraulics have been observed. The experimental test results on these items are not sufficient in themselves to permit making a design. Theoretical relationships, such as approach to equilibrium and hydraulics, are used to extend and interpolate the data that are available to conditions of interest. Whereas theoretical plate calculation methods are largely theoretical with no operating factors being involved, bubble plate efficiency and capacity correlations are mostly empirical. The large amount of experimental data required as well as the extremely complex nature of the problem have been obstacles to the development of sound process design methods for bubble plates. Although theoretical plate calculation methods and even vapor-liquid equilibrium data are dependable, there is still a great deal of guesswork involved in estimating bubble plate efficiencies and capacities. In this and the next installment, these subjects will be discussed and some methods of making approximations will be presented.

At the end of this installment several references are listed on bubble plate fluidynamics. References on entrainment and bubble plate efficiency will be given with the next installment. A complete discussion of all the information given in these references is not possible but all are included for the convenience of the reader.

FLOW PATTERNS

In carrying out the multi-stage vapor and liquid contacting necessary in the separation of hydrocarbons by absorption or fractionation, the liquid and vapor streams flow in opposite direction from stage to stage in the column. The vapor flows up the column due to a higher pressure at the bottom and the liquid flows down the column due to a liquid gravity head on each plate. The capacity of any contacting apparatus is a function of both liquid and vapor flow rates, the capacity of one decreasing as the rate of the other increases. Likewise the plate spacing or the distances between the stages determines the capacity of a column, because it is this dis-

FIG. 63. Bubble plate column vapor and liquid contact flow patterns.



EXCLUSIVE

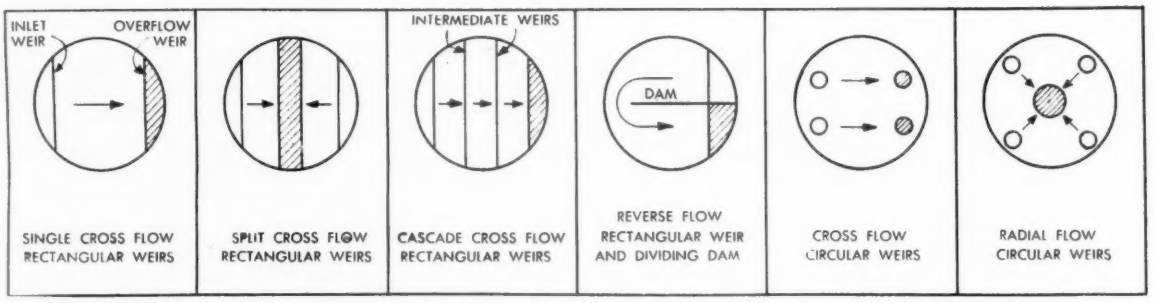


FIG. 64. Types of liquid flow on bubble plates.

tance that creates the gravity head of liquid and permits the liquid to flow down the column against the higher static pressure.

The principal reason why bubble plate columns are used in preference to packed columns for hydrocarbon separation operations is the higher capacities of bubble plates to handle vapor and liquid. Although a packed column has countercurrent flow between the vapor and liquid phases, packing has size and service limitations. In commercial sizes, the distribution of liquid and vapor constitutes a serious problem, making the packed tower impractical for most commercial hydrocarbon separation services. This distribution problem is aggravated by the fact that allowable superficial vapor velocity for packed columns is about half that for bubble plate towers. Thus a packed tower of 5 ft in diameter would be required to handle the same load that a 3.5-ft bubble tower would handle. Of course, the bubble tower would have to be much higher, which to a certain extent compensates for the difference in diameter, but not entirely. Uneven distribution makes the packed tower impractical except for laboratory units and special services. In addition to distribution troubles, fouling and ease of cleaning differences are in favor of bubble plate columns.

For the above reason the column capacity discussion will pertain to bubble plate columns. As mentioned above the vapor and liquid capacities are related through the various pressure drops. This is a special fluidynamic problem. Computing the various pressure drops is tedious and often uncertain because of the numerous assumptions necessary. For these reasons, empirical capacity correlations are frequently developed from data on plant towers known to be near or at flooding conditions. When a bubble tower has reached its maximum capacity, it floods and the counterflow of liquid and vapor stops and the plates fill up, thus interrupting the operation.

Fig. 63 illustrates the different flow patterns encountered in commercial operations. For purposes of comparison the packed column is shown along with the cross flow plates for one and two-pass operations. From these diagrams it can be seen that the flow pattern can have an appreciable effect on the plate efficiency although the local efficiency is independent of the flow pattern between stages. This is easily understood when one considers the fact that the liquid enters on one side of the plate from the plate above rich in the less volatile components, flows across and leaves the opposite side leaner in the less volatile components. The vapor to the plate may or may not be well mixed and of uniform composition, which has an effect on plate efficiency and which is dependent upon the turbulence. Two assumptions are possible, thorough mixing between stages and no mixing between stages. Likewise there are different possibilities for liquid flow, cross flow in opposite directions on alternate plates, and cross flow in the same direction on all plates. These two cases for each vapor and liquid give four pattern combinations of interest in considering the effect of flow patterns upon plate efficiency.

Fig. 64 shows six different liquid flow paths for bubble plates. These sketches will be discussed further below.

Liquid flow through groups of round and hex caps is shown on Fig. 65. The risers and caps are on triangular spacing, which makes the most efficient use of the area. There are four possible directions for the liquid to flow, two good and two bad, as indicated. The solid line arrows show how the liquid will flow around the caps.

TYPES OF BUBBLE PLATES

Any study of bubble plate fluidynamics must be concerned with the details of the trays, which include: Bubble caps, vapor risers, overflow weir, liquid downflow, downflow sealpot, and inlet weir. For best results all these details should be specifically established for the particular vapor and liquid loads of the column being designed.

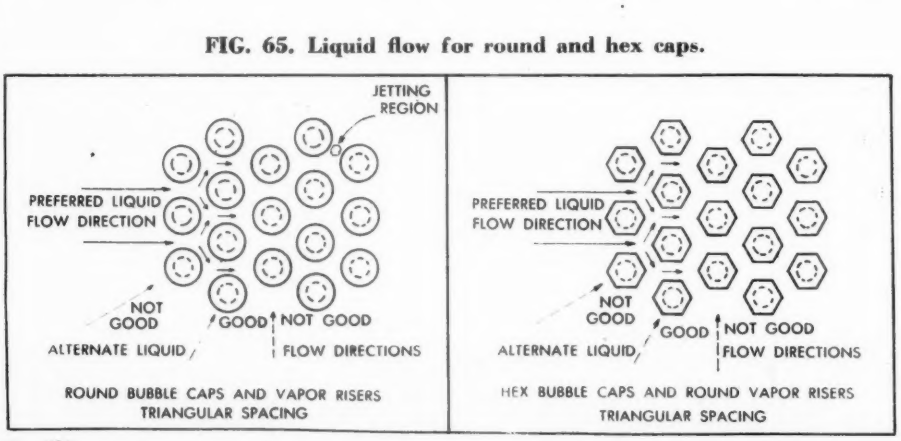
This is not always practical because bubble plates are manufactured in standard sizes with limited variations in the different dimensions. It is important that the plate and caps be well balanced so as to get uniform mixing without excessive pressure drop. Accordingly, bubble plate fluidynamics calculations are necessary to permit making the proper selection of plates.

Figs. 64, 65, 66, and 67 illustrate some of the features of bubble plates. Fig. 64 shows six different types of liquid flow. four with rectangular weirs and two with circular weirs, the single-pass tray with a rectangular weir being the most common. For high liquid loads it may be desirable to use a two-pass tray. For low liquid loads and high vapor loads the reverse flow tray is more suitable. For large diameter columns where the liquid gradient is appreciable, the cascade tray with intermediate weirs is used. In some cases circular weirs are satisfactory. Different flow patterns are obtained with circular weirs, which necessitates selecting the bubble caps accordingly.

Both Davies[5] and White[14] illustrated the liquid flow on bubble plates by similar sketches to those given in Fig. 64. with White indicating inactive areas where the liquid movement would be reduced because of bypassing. As the liquid will follow the paths of least resistance, it is possible to minimize. but not eliminate, this bypassing by the proper selection and arrangements of the bubble caps. White also includes some very good photographs of bubble plates and caps, the caps being round.

Fig. 65 shows two types of caps, round and hexagonal, in place with circular vapor risers. Round caps have the advantage of simplicity of installation as there are no straight sides to be set parallel with those of the adjacent caps. Both round and hex caps may be bolted down individually, thus requiring no holddown bars. This may be accomplished with or without a removable vapor riser. In one case the cap, riser, and holddown bolt assemblies are installed on a plate with the proper size holes at the desired spacing. In the other

FIG. 65. Liquid flow for round and hex caps.



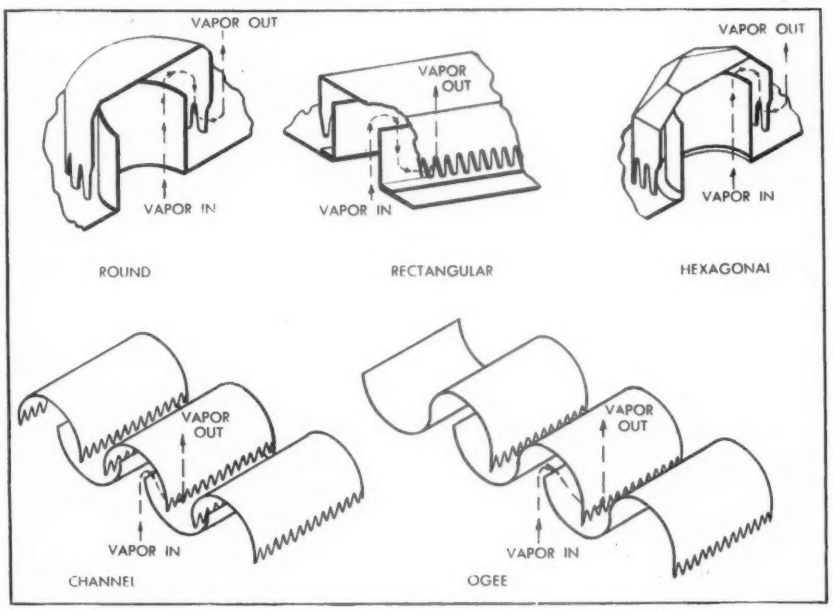


FIG. 66. Types of bubble cap vapor-liquid contacting devices.

case the vapor risers are integral with the plate. The sizes of the risers and caps and the spacing should be such that the vapor flow is uniform in velocity as changes in velocity use up pressure head. A balanced cap and riser has the cross-sectional areas of the riser and annulus equal. In these spaces the vapor will flow with directional changes but with no changes in velocity or encountering of liquid. The area around the caps should be greater than this dry vapor flow area to permit the bubbles formed in going through the slot to rise to the surface without making jets or geysers or blowing the liquid away from the cap. The velocity of the vapors leaving the surface of the liquid should be low enough to avoid projecting an excessive amount of liquid particles into the vapor space above.

On Fig. 65 it will be noted that the slots of adjacent round caps are at a variable distance apart, being close at one point. At high vapor loads this proximity of slot bubble streams can easily result in jets that occur at these points but not where the distances apart are greater.

Non-uniform bubbling like this does not result in efficient vapor-liquid contacting. With the hex type cap the constant distance between adjacent slots tends to give a more uniform mixing of the opposing vapor streams, thus reducing the possibilities of geysers.

Fig. 66 gives isometric views of five different types of bubble caps, portions of which are cut-away to show the vapor risers. Bubble cap holddown clamps, bolts and brackets are omitted from these drawings for simplicity. The round and hex caps were discussed above with reference to Fig. 65. The rectangular or tunnel caps are employed in the manner shown in Fig. 67. With tunnel caps the liquid flow is straight down the space between the caps along the long dimension of the caps with vapors bubbling

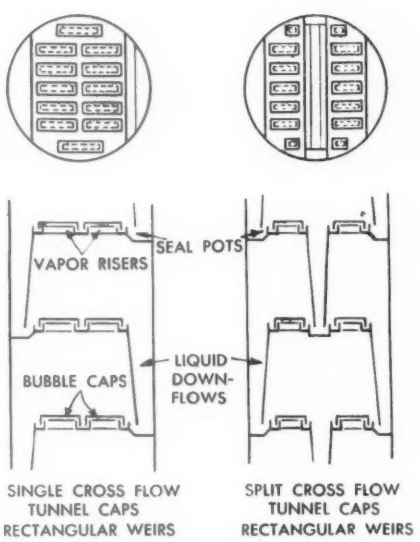


FIG. 67. One and two-pass bubble plates with tunnel caps and rectangular weirs.

through this liquid from slots in the caps on either side. This type of plate has a good liquid capacity because there are no obstructions to the liquid flow.

Two other types of vapor-liquid contacting devices are shown in Fig. 66. The channel type is an assembly of half cylinders arranged to form long continuous bubble caps and liquid troughs, as shown. The channel forming the cap has slots cut in the lower edges. Vapors from adjacent caps mix in the trough. Another style of continuous cap and trough bubble plate may be assembled from "S" shaped sections as shown in the sketch. In this design, which is called "Ogee," the flows are more streamlined, there being no opposing streams of vapor bubbles to form jets.

Precise installation of bubble plate parts is important to the successful operation. The plate and weirs should be level to obtain an even liquid flow. Sometimes it may be desirable to provide some pitch to the plate to compensate for the liquid gradient across the plate. This must be carefully done, however. Bubble caps should be set with uniform spacings and securely fastened to the plate. Assembly is more critical for the channel and ogee integral units, where maladjustments might cause liquid to spill through the vapor risers rather than flow across to the overflow weir.

BUBBLE PLATE OPERATION

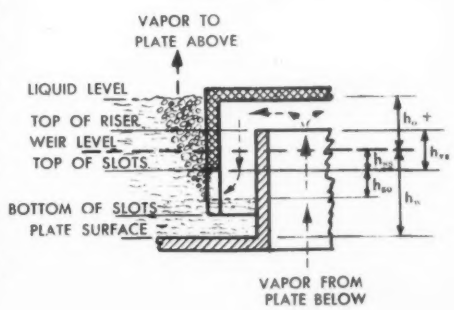
A clear understanding of the operation of a bubble plate is helpful in calculating pressure drops, in designing the elements of the plate and in determining the proper distance between plates. Figs. 67, 68, and 69 illustrate the features of bubble plate operation.

Fig. 67 shows sectional plan and elevation views of one and two-pass plates with tunnel caps and rectangular weirs. These are common designs in the petroleum industry. It is clear from the drawings that the single-pass tray has more cross-sectional area devoted to vapor flow and that the two-pass tray has more cross-sectional area devoted to liquid flow. The split cross flow tray is more suitable for large liquid loads and large diameter columns because: (a) The downflow area is a higher percentage of the tower cross-sectional area, (b) the distance of liquid travel from inlet sealpot to overflow weir is shorter.

Fig. 68 is a sectional elevation of a bubble cap and riser illustrating the bubbling action necessary for vapor-liquid phase contact. It will be noted that the bottom of the slots does not rest on the plate surface. The distance apart is immaterial so long as the bottom of the slots dips into the liquid, as shown. At very high vapor velocities the liquid may be blown away from the base of the riser, thus giving an open space for vapor to get through without going through the slots and being broken up into small vapor bubbles.

The weir level is indicated as intermediate between the top of the slots and the top of the riser. The weir must be high enough to submerge the slots at no liquid flow. On the other hand, the weir

FIG. 68. Sectional elevation of bubble cap and riser illustrating bubbling action.



and the static submergence should not be unreasonably high because of the pressure drop of vapor. The dimensions shown on Fig. 68 have the following identifications:

h_w = weir depth

h_o = weir crest or head over weir

h_{ss} = static or slot submergence

h_{so} = slot opening

h_{vs} = vapor riser submergence

Other heads are shown on Fig. 69, where the definitions are given.

Referring to Fig. 68, it can be seen that the gas pushes liquid down and out of the cap until the slots are open widely enough for the vapors to bubble through. Rogers and Thiele[11] developed equations giving slot opening as a function of vapor quantity for triangular and rectangular slots. They also made experimental measurements on the flow of gas through a laboratory slot in liquid to confirm the equations, which are of value in calculating bubble size for estimates of diffusion rates.

Fig. 69 includes a sketch showing how the various pressure drops cause the liquid to build up in the downspout. This head of liquid in the downspout is necessary to balance the pressure drop and maintain liquid flow down the column.

VAPOR AND LIQUID FLOWS

In a bubble plate column vapor flows upward, from plate-to-plate, whereas liquid flows downward, from plate-to-plate. The designer is concerned with the mechanisms of flow on the plates and also between the plates. Although operated continuously, bubble plates are technically stages in an intermittent unit.

Vapor flow originates at the bottom of the column, either as the wet gas in the case of an absorber or as vapors from a reboiler in the case of a fractionator. The vapor fraction of the feed will join the vapor from the stripping section, giving the total vapor in the enriching section of a fractionator. Liquid flow originates at the top of the column, either as lean oil in the case of an absorber or as reflux in the case of a fractionator. The liquid fraction of the feed will join the liquid from the enriching section, giving the total liquid to the stripping section of a fractionator.

Cicalese et al[3] presented in a recent T. A. C. report a very good description of the operation of a fractionator, discussing gas flow and liquid flow separately. Considering the flow of vapor through a plate with liquid flowing across it, these authors divided the space involved into zones as follows:

(a) Unagitated liquid next to the plate and underneath slots;

(b) Agitated liquid and foam between lower opening of slot and somewhat above the level the liquid would have with no vapor bubbling through it;

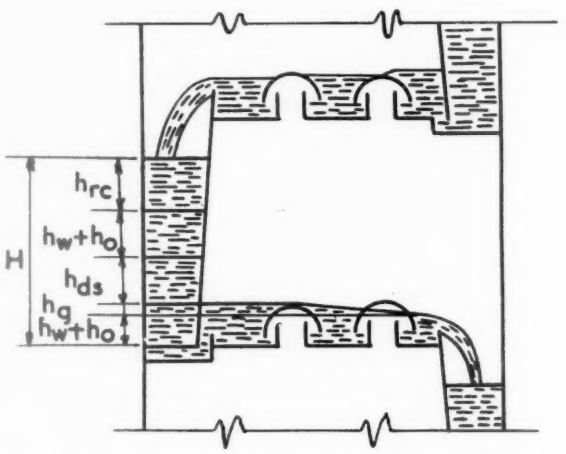
(c) A dense zone of small droplets projected from the agitated liquid and foam by high velocity vaport and extending as high as conditions determine, and

(d) A zone of entrained mist between the droplet zone and the plate above.

These four zones are of progressively decreasing liquid and increasing vapor content. Liquid particles that reach the plate above by going through each of these zones decrease the plate efficiency. The vapor velocities should be high enough to get good contacting but not so high as to result in excessive entrainment.

Liquid flows through the path of least resistance and piles up enough depth to keep flowing through any resistances that might be in the way, flowing around, over, or between bubble caps. If the re-

FIG. 69. Approximate calculation methods for bubble plate pressure drops.



All pressure drops are expressed as inches of liquid at operating conditions.

$H = 2(h_w + h_o) + h_g + h_{ds} + h_{rc}$ = total pressure drop inches of liquid. When corrected for densities, H represents the depth of liquid backup in downspouts.

h_w = Weir depth—assumed or given as part of tray details.

h_o = head over Weir—computed from Weir formula using effective length and discharge coefficients from correlations.

h_{rc} = head lost by vapor in contraction and expansion through the vapor risers and caps of a dry plate. Allow one vapor velocity head for expansion and one-half for contraction. Use an orifice discharge coefficient of 0.45 for the dry plate.

$$h_{rc} = \frac{1.5}{62.4}\,\frac{12}{0.45^2}\,V_r^2\left(\frac{\rho_V}{\rho_L}\right) = 1.43\,V_r^2\left(\frac{\rho_V}{\rho_L}\right);$$

Where: V_r = velocity through riser, ft./sec.

ρ_V and ρ_L = densities of vapor and liquid.

h_{ds} = head lost by liquid in contraction and expansion through downspout and sealpot. Allow one velocity head for expansion and one-half for contraction. Use an orifice discharge coefficient of 0.6 for the sealpot.

$$h_{ds} = \frac{1.5}{62.4}\,\frac{12}{0.6^2}\,V_s^2 = 0.8\;V_s^2,$$

where V_s = velocity through sealpot, ft./sec.

h_g = head lost due to liquid gradient across tray. Use friction factor equation with equivalent or hydraulic diameter and an assumed average friction factor for turbulent flow.

$$h_g = \frac{0.746}{48}\,\frac{0.005}{A/P}\,12\;V_p^2\;L = 0.00093\,\frac{V_p^2\,L}{A/P}$$

Where: V_p = average velocity of liquid on plate, ft./sec.

A = average cross sectional area of liquid stream.

P = average wetted perimeter in feet.

L = length of path of flow in feet.

$H_{corr} = H\left(\frac{\rho_L}{\rho_L - \rho_V}\right)$ = height liquid will backup in downspout, assuming no foaming.

sistance to flow is great enough the depth of liquid at the inlet side of the tray will be substantially higher than the depth at the outlet side. This difference in liquid depth, or liquid gradient, will result in an uneven distribution of vapor with more vapor going through the caps at the outlet side where the liquid depth is least. If this difference is sufficient the vapor will not flow through the caps on the inlet side and liquid will dump or backtrap through the vapor risers.

From the standpoint of balanced and efficient operation, the liquid gradient is very important. It is frequently necessary to employ cascade or two-pass trays to avoid distribution difficulties. In designing a tray it may be necessary to calculate the liquid gradient carefully in order to be assured that the plate is well balanced.

Davies[5] has derived equations for calculating the liquid gradient. An approximate and rapid equation for calculating liquid gradient is given in Fig. 69, which will be discussed later.

COLUMN FLOODING

As shown in Fig. 69, the liquid must rise in the downspouts to offset the pressure drop across the plate and keep the liquid flowing down the column. This is an essential feature of the operation of the column so the plates should be spaced far enough apart to allow for this liquid head. The liquid overflowing the outlet weir will contain some dissolved vapors so the liquid in the downflow will be expanded in volume accordingly.

In some plates a vapor releasing zone is provided near the top of the downflow, either before or after the overflow weir. Most downspouts are larger at the top than at the bottom for this reason. Liquid flowing over a weir will release some but not all dissolved vapor.

If the liquid rises too high in the downspouts, the column will flood, prime, or puke. In other words, liquid flow will stop and the column will fill up with liquid. For a given style of bubble cap flooding can be avoided by:

(a) split flow of liquid,
(b) increased plate spacing, or
(c) increased tower diameter.

Changes in the liquid cannot be made independent of the vapor. Increasing tower diameter may decrease vapor velocity to the point where the vapor-liquid contact is inefficient.

If flooding difficulties should be encountered in an operating tower, some increased liquid capacity can usually be obtained by notching the weir to give a serrated weir with greater effective length.

Plate spacing may be determined by making pressure drop calculations to find how high the liquid will stand in the downflows. To be perfectly correct these calculations should include an estimate of the amount of vapor dissolved in the liquid so as to get the actual density and from this the height the liquid will rise. It is not practical to estimate the actual densities of the frothed-up liquid.

Usually calculations are made in terms of clear liquid at the operating temperature and pressure conditions. Calculations made this way give an apparent, but lower depth in the downspout. Plate spacing is then made about twice this apparent liquid depth to be conservative and at the same time make allowance for the frothed up liquid.

PRESSURE DROP CALCULATIONS

The plate details, the quantities of vapor and liquid, and the properties of the fluids determine the pressure drop through a bubble plate. Several worthwhile contributions have been made on this subject.

Chillas and Weir[2] were among the first to apply rational engineering calculation methods to bubble plates. Kirkbride[8] outlined a calculation procedure for sizing bubble plate fractionators. Davies[5] presented a very good treatment of liquid gradient in which he showed how all the pressures may combine to give an unbalanced or a priming column.

Referring to Fig. 68, it can be seen that the vapor pressure drop will consist of the drop through a dry plate plus the drop through the liquid above the slot, the latter including the static submergence and the head over the weir plus the liquid gradient at the point in question. This liquid gradient will vary from a maximum at the inlet to a minimum at the outlet side. In other words, the vapor does not have to bubble through the liquid below the slot so this depth should not be included in the calculation. This is the way Davies[5] wrote his equations. As there are so many uncertainties involved in calculating bubble plate pressure drops the author proposes assuming that the vapor must bubble through all the liquid on the tray. This will be slightly conservative and somewhat simpler but not strictly correct.

The bubble plate pressure drops and proposed methods of approximating them are shown on Fig. 69, which shows how the different pressure drops must be counterbalanced by a depth of liquid in the downspout.

Referring to Fig. 69, the various pressure drops are defined and calculated as follows:

h_w = weir depth, which is given or assumed;

h_o = head over weir, which is computed by weir formula using effective weir length (Fig. 70) and discharge coefficient (Fig. 71);

h_{rc} = the head lost by the vapor in contracting and expanding through the risers and caps, which is computed as 1½ vapor velocity heads;

h_{ds} = the head lost through the downspout and sealpot, which is calculated as 1½ liquid velocity heads, and

h_g = the head lost due to the liquid gradient across the plate and may be calculated by estimating the clear area of flow, the wetted perimeter, etc., using an assumed friction or turbulence factor.

The summation of these different pressure drops when corrected for the difference in the liquid and vapor densities will give the distance that the liquid will back up in the downspout. It is obvious from reference to Fig. 69 that a column will flood when the liquid backs up too far in the downspout.

Equations are given for calculating the vapor drop through the riser and caps, the liquid drop through the sealpot, and the liquid gradient. Davies[5] has developed equations for the liquid gradient that take all factors into consideration but are rather complex.

One of the unknowns in making this type of calculation is the foam. The liquid is never quiescent because in going through the caps the vapor makes foam and this foam does not completely break away until the liquid is in the downspout. Actually it is necessary to allow for some vapor releasing in the top of the downspout.

The total height that liquid will back up, the downspout is the sum of all these drops with h_w and h_o included twice because of the point from which the distance is measured, namely the surface of the plate. Davies[5] measures from the weir and includes the weir crest, h_o, twice. The two are consistent except for the fact that Davies uses static submergence of the slot whereas Fig. 69 uses the weir height. Fig. 69 is therefore conservative in two respects. The interpretation of the results of such a calculation are most important.

WEIR CREST

In computing the head of the weir it is a customary practice to use weir formulae with a constant discharge coefficient and also use the full lengths of the weirs. Neither of these simplifications, however, is correct because the weir is restricted by the curved sides of the tower and also because the approach velocity of the liquid on the weir is not negligible.

The effective weir length will be less than the actual length depending upon the amount of the restriction, which will depend upon the column diameter, the length of the weir, and the head over the weir. These factors are illustrated on Fig. 70 where the different dimensions are indicated on the sketch.

The effective weir length is assumed to be the chord made by drawing the dashed line parallel to the actual weir at a distance of h_o (where h_o is the head over the weir) toward the shell. This assumption is based on the fact that the curved sides of the column will restrict the ends of the weir where the liquid hits the vessel wall.

As the Francis weir formula is for a free flowing rectangular weir these restricted ends will not be effective. Accordingly, it will be assumed that the effective length of the weir is W′, as shown in Fig. 70. With this assumption the effective length W′ is a function of the column diameter, D, the actual weir length, W, and the liquid head over the weir, h_o.

Applying simple geometry to the plan view in Fig. 70 and using these

dimensions, permits deriving equations relating the ratios $\frac{W}{D}$ and $\frac{M}{D}$ and also the ratios $\frac{W'}{D}$ and $\frac{M'}{D}$.

These equations are shown on Fig. 70, which also contains a plot W/D (W′/D) vs M/D (or M′/D). This curve is used to find W′ in the following manner:

Step 1: Calculate W/D and h_o/D from the known dimension of the tower, and weir and the assumed or given value of h_o.

Step 2. From the curve find the value of M/D corresponding to W/D.

Step 3. Calculate M′/D from the relation

$$\frac{M'}{D} = \frac{M}{D} - \frac{h_o}{D}$$

Step 4. With this value of M′/D, find W′/D from the curve.

Step 5. Calculate W′ by multiplying the ratio $\frac{W'}{D}$ by D.

This computation will be illustrated by the following example, for which solution dashed lines with arrows indicate the method of using the curve in Fig. 70.

Example 42: Find the effective weir length for a column 5 ft 3 in. in diameter having an actual weir length of 4 ft 2 in and a weir crest of 2.5 in.

Step 1. $\frac{W}{D} = \frac{50}{63} = 0.795$;

$$\frac{h_o}{D} = \frac{2.5}{63} = 0.040.$$

Step 2. From Fig. 70, using

$$\frac{W}{D} = 0.795, \quad \frac{M}{D} = 0.198$$

Step. 3. $\frac{M'}{D} = 0.198 - 0.040 = 0.158$

Step 4. From Fig. 70, using

$$\frac{M'}{D} = 0.158, \frac{W'}{D} = 0.735.$$

Step 5. $W' = 0.735 \times 63 = 46$ in.

The use of Fig. 70 to compute the effective weir length requires first assuming or estimating the weir crest. This estimation may be done by assuming the effective weir length, from which an approximate value of the weir crest may be calculated. This estimated value of h_o, may then be used to compute the effective weir length, W′. For these calculations a weir discharge coefficient must be found and used and Fig. 71 may be used to find the weir discharge coefficient.

The equation for a rectangular weir is derived by considering a small incremental section of the weir as an orifice and integrating over the length of the weir and the depth of the weir crest. It is customary to assume that the approach velocity is negligible, which is usually the case. This gives the following weir equations:

$$Q = 2.98\ W\ h_o^{3/2} \quad . \quad . \quad . \quad . \quad (180)$$

Q = flow rate, gpm,

W = weir length, inches,

h_o = height of weir crest, inches.

When the weir length and crest dimensions are in feet the constant equation 180 becomes 3.33.

For bubble plates, the approach velocity is not negligible so a variable discharge coefficient must be used. The weir discharge coefficient, K_w, will clearly be a function of the weir height and the weir crest in the same manner the discharge coefficient of a round orifice in a round pipe a function of the ratio of the diameter of the orifice to the

FIG. 70. Effective lengths for suppressed rectangular bubble tray weirs.

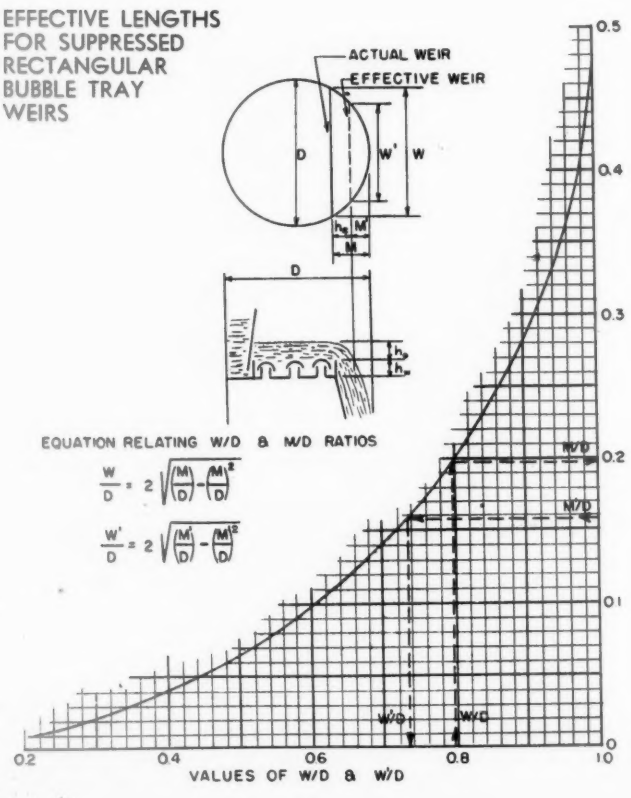
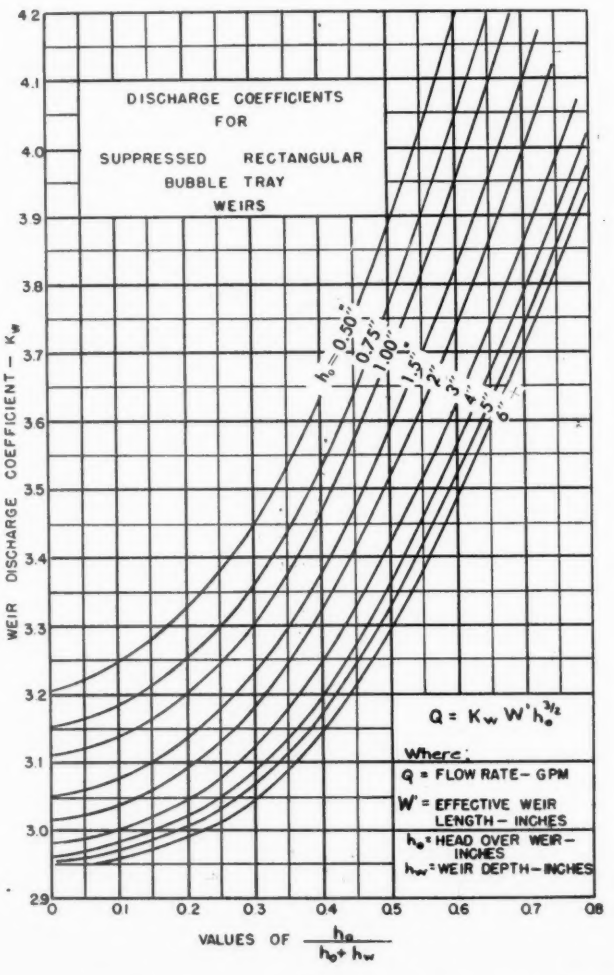


FIG. 71. Discharge coefficients for suppressed rectangular bubble tray weirs.



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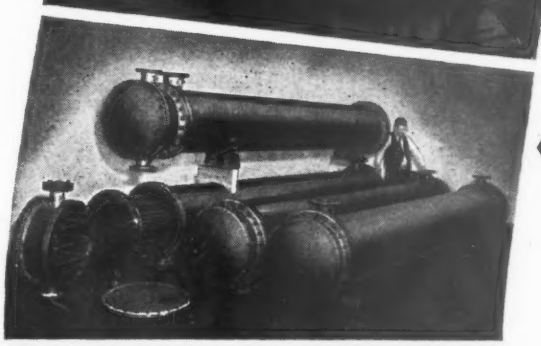

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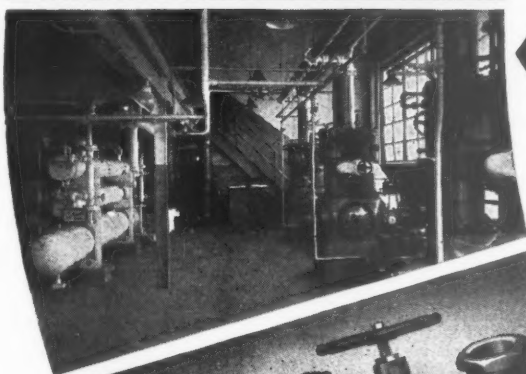

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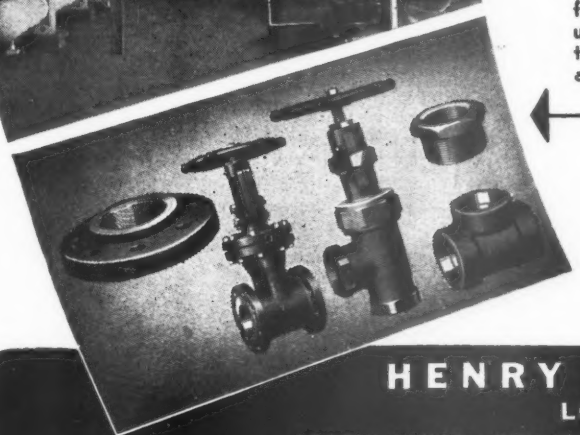

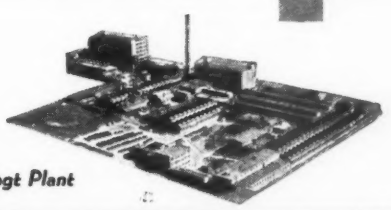

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diameter of the pipe. This defines the shape of the K_w vs $h_o/(h_o+h_w)$ curves in Fig. 71.

In constructing Fig. 71 it was necessary to draw a parameter of curves for different values of h_o because of an independent effect of weir crest on the discharge coefficient. This is a correction only necessary for weir crests below 6 in., which range includes bubble tray weirs. This effect was found at variable weir heights where the approach velocity was negligible and the curves in Fig. 71 were drawn in parallel with the lower, or 6-in.+, curve.

By these means, Fig. 71 was constructed and is offered as a tentative chart for finding the discharge coefficient of rectangular bubble plate weirs. Although it was prepared from very few data and analogy, Fig. 71 is believed to be at least approximately correct. As the curves were drawn through their lower end values parallel to the curve for $h_o = 6$ in.+, the latter in turn being drawn parallel to a orifice curve, there is reason to be skeptical of the upper portions of the curves for low values of h_o.

In using Fig. 71 it is necessary to use an assumed value of h_o. This amounts to a trial and error calculation where the assumed value of h_o is checked after the discharge coefficient and the effective weir length are found from Figs. 70 and 71.

VAPOR LOSS

The loss in vapor head in passing through the plate is usually figured in two parts, i.e. the drop through a dry plate plus the drop in going through the liquid on the plate. This flow is shown in Figs. 66, 67, and 68. In Fig. 66 it can be seen that the vapor must contract to enter the risers then go through two direction reversals and then expand. The main sources of losses will be contraction and expansion. Friction is very small by comparison.

One way of estimating this pressure drop is shown in Fig. 69 where one velocity head is used for expansion and one-half velocity head for contraction. An orifice discharge coefficient for the dry plate is taken as 0.45. The resulting equation is given in Fig. 69.

In T.A.C. report FMC-15 Cicalese et al[3] gave equations for each of the following drops incurred by the vapor in flowing through the riser and cap:

(a) pressure drop through the riser,

(b) reversal pressure drop, and

(c) drop through dry slots.

The sum of these three dry plate pressure drops is then corrected for the liquid on the tray by a chart developed by Dauphine[4].

The source and development of the equations given in the report by Cicalese et al[3] for calculating vapor pressure drops is Dauphine's[4] thesis. No comparison of these equations with the one given in Fig. 69 has been made. The T.A.C. report equation, however, should be more accurate because it is flexible enough to allow for any combination of dimensions.

LIQUID GRADIENT

The liquid gradient will depend upon the resistance to flow, which will depend upon the type and arrangement of caps, the length of the path and the quantity of liquid flowing. Davies[5] (see also reference 3) developed equations for the liquid gradient for round caps and risers spaced on triangular or square pitch. These equations are accompanied by two graphs, one for an equation constant and one giving a correction factor.

Davies' equations are limited to round caps, where the flow pattern makes the equation very complex (see Fig. 65). Many trays are equipped with other type trays, for which these equations do not apply.

In Fig. 69, an equation is given for estimating the liquid gradient. This equation does not pretend to take into account all the factors or to represent a rigorous expression. It is rapid, however, and may be applied to rectangular caps.

No comparison has been made of these equations for liquid gradient. Such a comparison would be difficult because the two equations are for different cases.

DOWNFLOW AND SEALPOT

The pressure drop in flowing down the downcomer may be neglected but the drop through the sealpot will often be significant. An equation for this item is also given in the T.A.C. report[3].

In Fig. 69 this drop is figured as 1.5 velocity heads with a 0.6 orifice discharge coefficient. The equation in Fig. 69 gives a result that is approximately 35 per cent higher than Cicalese et al[3] equation, for which the basis is not clearly stated. This item is small fraction of drop, however.

EMPIRICAL RELATIONSHIPS

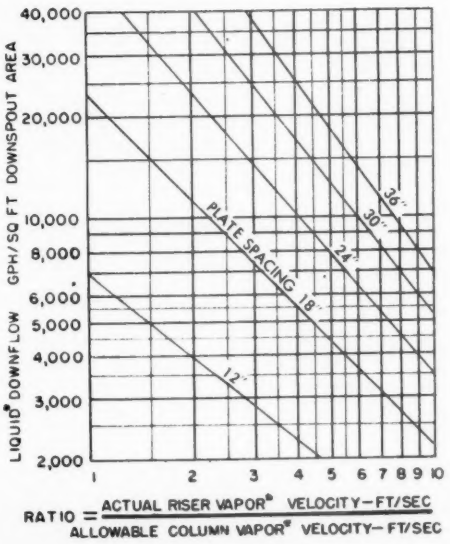
There are so many uncertain factors such as foam, non-level plates, missing or loose bubble caps, etc., in the operation of a bubble plate column that it is frequently a waste of time to use rigorous methods of calculating pressure drop. Short cut calculation methods are often adequate to locate troubles or to make new designs. For special cases the more rigorous equations can be used.

Frequently empirical correlations, such as Fig. 72, may be developed from plant operating data and/or from pressure drop calculations. Such a correlation would be of limited applicability, but several could be made to cover the variables, fluids, and equipment of interest. A plot, such as Fig. 72, would be based on the assumption of a properly designed and balanced tray. The scales shown do not include any bubble cap details.

Fig. 72 represents the relationship that exists between the liquid downflow rate and the vapor rate for different plate spacing for commercial petroleum bubble towers. The liquid downflow rate is plotted as gallons per hour at the tower operation conditions per square foot of downspout area versus the ratio of the actual vapor velocity through the vapor-riser to the allowable column superficial vapor velocity. This plot is intended to illustrate the trends and should be considered for reference only and not to be used in design. Such a plot could be prepared for each type of service involved and for the types of plates and other details employed.

Actually the column capacity is not as simple a function as is indicated on Fig. 72 because the details of the plate determine the pressure drop, which determines the capacity.

FIG. 72. Approximate relation between liquid and vapor loads for various plate spacings.



*At tower operating conditions.

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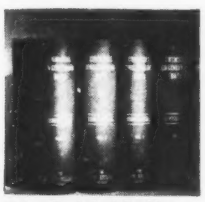

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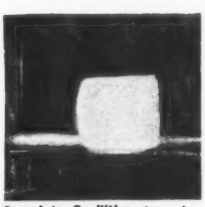

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To be sure, leaks that exist in an exchanger upon completion of assembly can be caught on the plant test blocks before shipment—but refiners will tell you that plant testing is no sure indication of faultless service in actual refinery operation.

For a man can *over*-expand the tubes—can make tight, leak-proof connections, but in so doing can weaken the tubes and tube sheets themselves without visible indication—and so actually *build in* service failures.

As a result, final performance of heat exchangers actually hinges on the degree and quality of both mechanical and psychological control, for this is both a *mechanical* and a *human* problem.

Many years ago, Kellogg installed an intricate and effective system of gauge checking every single tube expansion—to insure against the *mechanical* factor. Over the years, familiarity with the *human* quotient in precision fabrication has evolved a system of labor evaluation and supervision—a system that reduces the element of *human* error to a veritable minimum.

Knowledge of the necessity for maintaining such rigid and time-consuming guarantees against service failure has been responsible for Kellogg's *custom-built approach* to the fabrication of all types of refinery equipment. Knowledge of the beneficial effect that this *"greater-attention-to-detail"* has on service life, makes continuation of that *custom-built approach* a Kellogg maxim, regardless of keen competitive pricing within the field.

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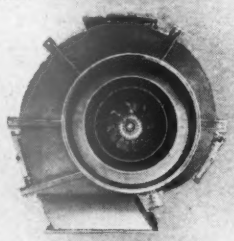
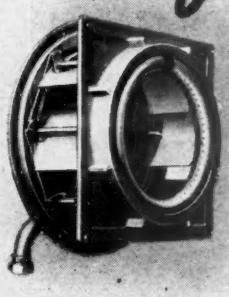
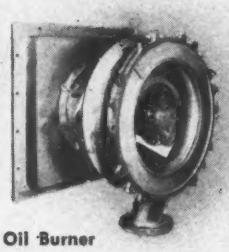


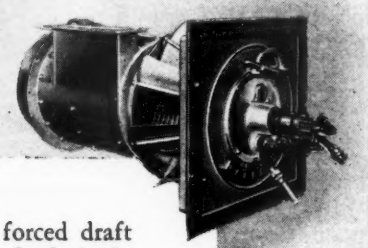


Petroleum Refinery Burner for Gas and Oil

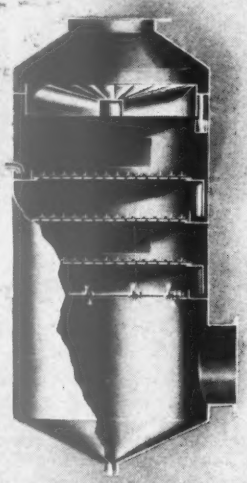


Combined Gas and Oil Burner

Combined Coal and Oil Burner



Gas Scrubbers, Coolers, Absorbers



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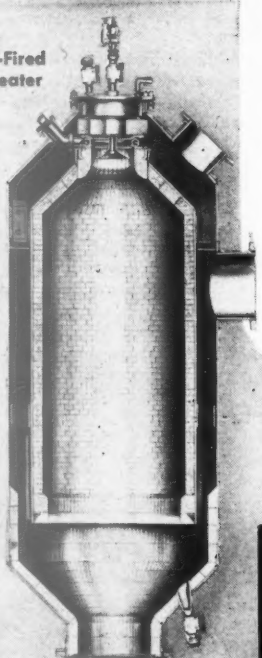

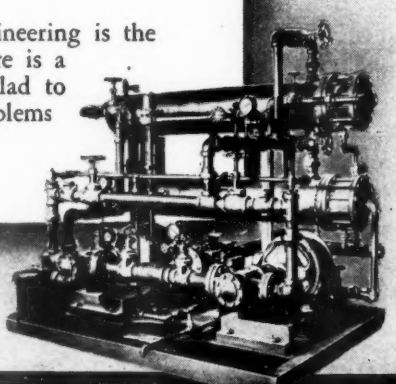

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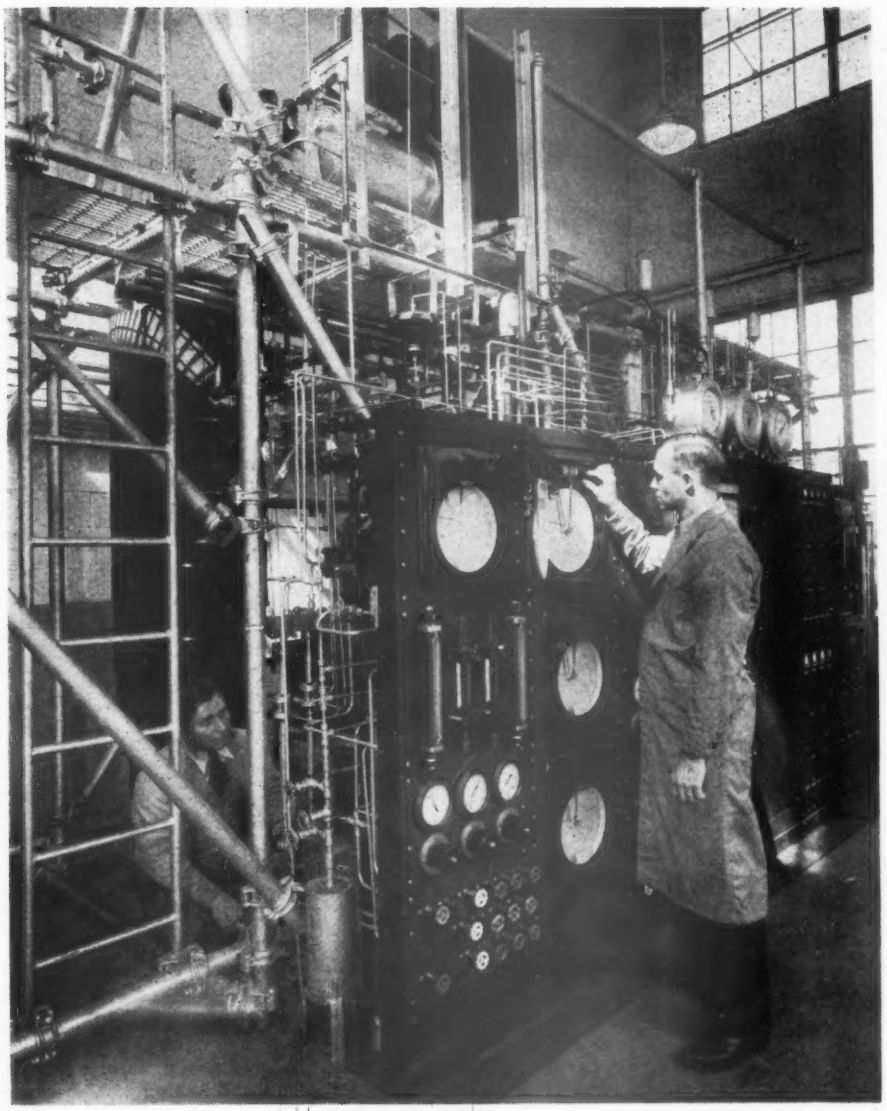


Experimental synthetic hydrocarbons pilot plant of Gulf Research and Development Company, which produces one gallon per day of total hydrocarbons requiring two operators per shift.

Problems Associated With Fischer-Tropsch Process*

By EUGENE AYERS, C. W. MONTGOMERY, and JOEL H. HIRSCH†

So much has been written and said about the Fischer-Tropsch process that even the most sophisticated research man in the field has been sometimes under the hypnotic impression that here is a *fait accompli*—a fundamentally successful development that requires only a few little technical touches here and there to make it perfect. There are many things to praise about the American chemical engineering development of the German process. It has been a technical achievement of a high order. But it may be more constructive at this time to stand off a bit and look at some of the difficult and interesting problems that are yet to be solved.

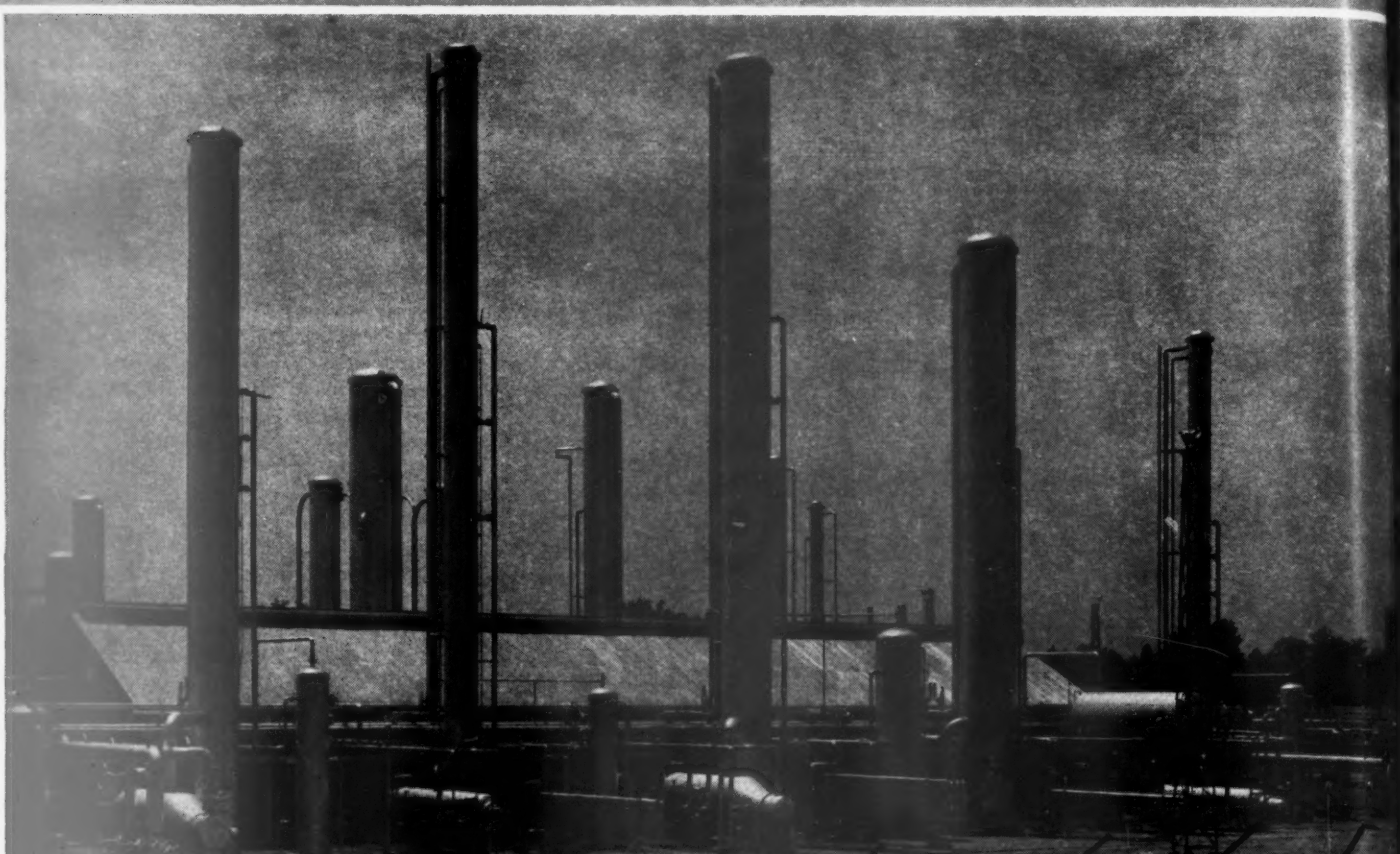
*Presented before the ASME Petroleum Mechanical Engineering Conference, October 5, 1948, at Amarillo, Texas.

†Gulf Research and Development Company, Pittsburgh, Pennsylvania.

The Fischer-Tropsch conversion of synthesis gas (carbon monoxide and hydrogen) to motor fuel differs from most production processes in that great volumes of raw product must be handled to make relatively tiny volumes of finished product. About 2000 volumes of synthesis gas plus recycle gas are passed through the reactor to make one volume of liquid motor fuel. The significance of this observation is that while costs must be applied against the one volume coming out, the equipment must be sized to take care of the 2000 volumes going in. Thus, the largest part of the cost of the synthesis is on account of the amortization and maintenance of equipment.

With this process characteristic in mind, American chemical engineers have endeavored to push the process toward more economic space-time yields. This has been done by imposing operating conditions much more severe than those used by the Germans. Under typical German conditions care was taken, through the use of relatively low and rigorously controlled temperatures and space velocities, to avoid overloading the catalyst. As a result, the undesirable side reactions which tend to occur on the catalyst under modern synthesis conditions were either non-existent or of only minor importance. Thus, in improving space-time yields we have greatly aggravated our catalyst problems. In fact, the current tendency is to seek such cheap, naturally occurring or by-product iron catalysts that catalyst life is not economically controlling. Such an attitude might seem to be justified at the moment by relatively favorable over-all economics, but it amounts to solving the catalyst problems by ignoring them, and such a course may lead to neglect of a broad field of research in which promising advances may be ultimately expected. In the following section we shall discuss briefly a few of the more important catalyst side reactions taking place during the Fischer-Tropsch synthesis, study of which, we believe, should prove profitable.

The problem of carbon deterioration of iron Fischer-Tropsch catalysts can be most serious. Under carefully controlled conditions, particularly at temperatures somewhat lower than



OIL HEATED KEROSENE FRACTIONATOR REBOILER

DE-PROPANIZER REBOILER

TWIN G-FIN DE-PROPANIZER EXCHANGER

DE-BUTANIZER REBOILER

TWIN G-FIN SECTION DE-BUTANIZER BOTTOMS EXCHANGER

TWIN G-FIN SECTION FRACTIONATOR FEED EXCHANGER

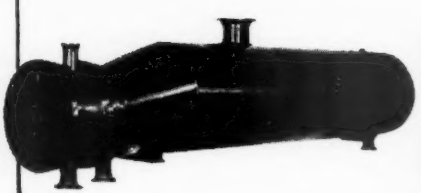
DE-ETHANIZER REBOILER

TWIN G-FIN SECTION BOTTOMS EXCHANGER

This portion of a large modern south-western natural gas absorption plant contains the G-R apparatus listed above. The plant also contains 60 G-R Bentube Sections and a large number of G-R Tubular Heat Transfer Apparatus not shown in the illustration.

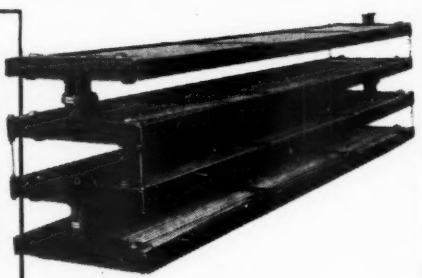
G-R REBOILERS

For producing vapor from liquids heated with steam or hot liquids. The illustrated kettle type has a large vapor space above the tube bundle.



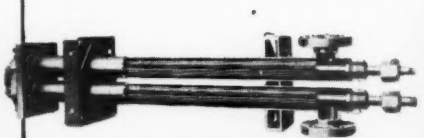
G-R BENTUBE SECTIONS

Patented design of atmospheric or submerged cooling and condensing sections consisting of parallel rows of tubing set with slight initial bow into cast header at each end. Change in temperature causes corresponding change in curvature of the tubes which cracks up and breaks off scale.



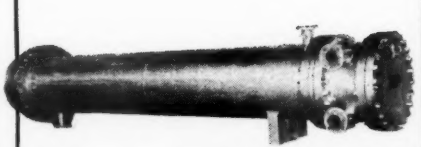
G-R TWIN G-FIN SECTION

Standard, interchangeable units of patented hairpin design, consisting of a single G-Fin element, with longitudinal fins within a shell. More than 40,000 of these units are used on practically every heating, cooling or condensing service.



G-R TUBULAR EXCHANGERS

Include many patented features based on 80 years of experience in building heat transfer apparatus. Available in a wide range of types for condensing, heating, cooling or exchanging heat between liquids, gases and vapors.



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A good example of G-R "RANGE-ABILITY" at this plant

"RANGE-ABILITY"... the ability to serve efficiently through a wide range of service requirements . . . is a characteristic of G-R Heat Transfer Apparatus.

For example, in G-R Twin G-Fin Sections, this "RANGE-ABILITY" is obtained by simply connecting, in series or parallel, as many of these standard, interchangeable units as required by the duty. The accompanying photograph is a good illustration. This modern natural gas absorption plant uses four banks of G-R Twin G-Fin Sections as follows:

- De-propanizer Exchanger — 3 sections connected in series
- De-butanizer Bottoms Exchanger — 3 banks in parallel, each bank containing 4 sections in series
- Fractionator Feed Exchanger — 2 sections connected in series
- De-ethanizer Bottoms Exchanger — 4 sections connected in series

The same plant uses 60 G-R Bentube Sections (not shown in the illustration) for cooling tower service. These sections are another example of G-R "RANGE-ABILITY" obtained through standard designs, and are operating at pressures ranging from 125 psi to 2750 psi in this plant.

In other types of G-R apparatus, "RANGE-ABILITY" is obtained by designs which cover all duties. For example, the accompanying photographs also show various types of steam-heated and oil-heated reboilers; and the same plant is using many other designs of G-R Tubular apparatus as still feed preheaters, vapor condensers, oil-to-oil exchangers, gas heaters, gas coolers and aftercoolers.

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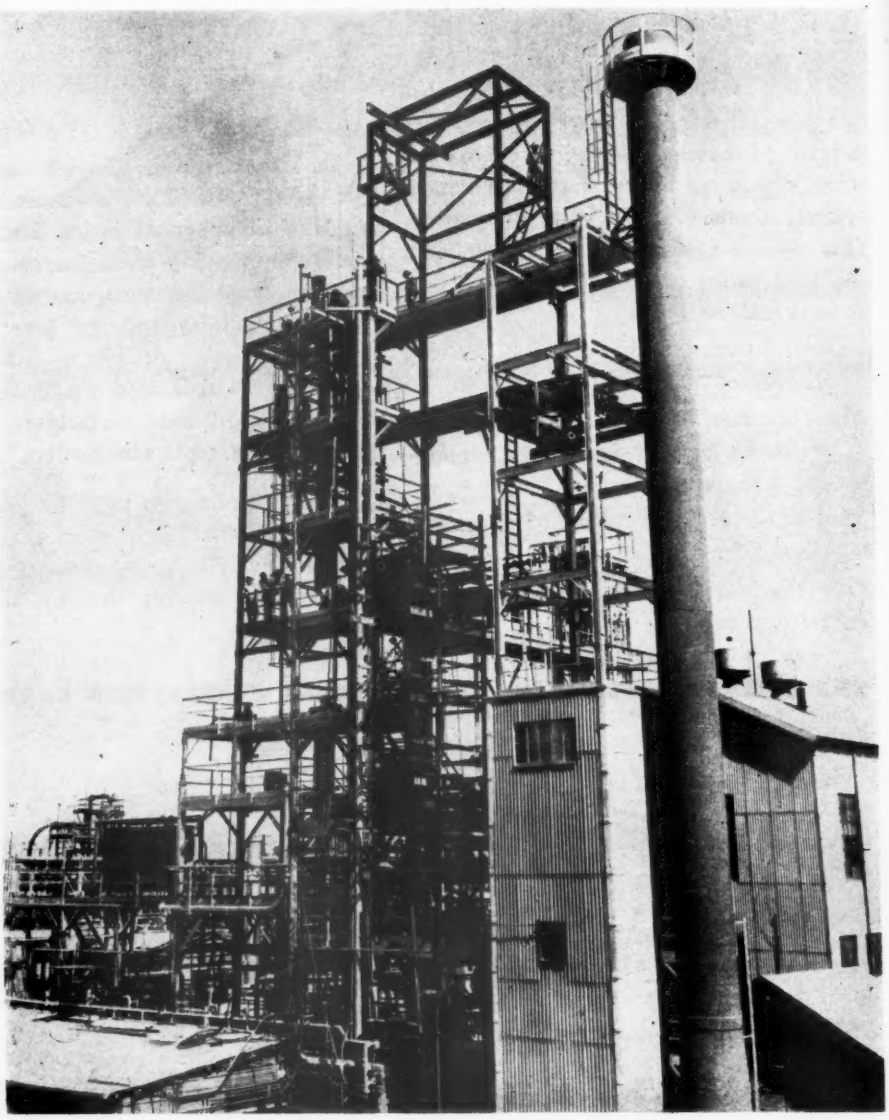
those obtaining during synthesis, the transition metals, iron, cobalt, and nickel, will react with carbon monoxide to form, predominantly, carbides with compositions approximating M_2C or M_3C. At one time these were regarded as essential intermediates in the synthesis of hydrocarbons. It has since been shown that reduction of bulk carbides with hydrogen produces principally methane and only traces of the higher hydrocarbons that are actually formed in the synthesis. At synthesis temperatures, and progressively more rapidly at higher temperatures, carbon monoxide will deposit carbon on the transition metals far in excess of the stoichiometric amounts indicated by the previous formulas for the carbides. The carbides themselves are thermodynamically metastable with respect to free carbon at temperatures below those of the blast furnace, but they can be prepared at low temperatures by virtue of their slow rates of decomposition. As these rates become appreciable the carbon, which was uniformly distributed through the metal lattice in the carbide form, tends to diffuse and accumulate in inclusions, thus freeing lattice sites for the addition of more carbon. Now on account of the small atomic radii of iron, cobalt, and nickel, the interstitial volumes between the metal atoms are correspondingly so small that even the amount of carbon required for carbide formation can scarcely be accommodated without lattice expansion. As might be expected, the excess carbon encountered above normal synthesis temperatures disastrously strains the metal catalyst structure. With granular or pelleted catalysts almost complete powdering with resultant excessive pressure drops through fixed beds may occur in a matter of minutes. Conventional fixed bed operation in which "hot spots" are frequently present is especially vulnerable to this type to catalyst deterioration, but even fluid operation is not entirely free from it. In the latter case even when the fluidized bed of catalyst is apparently uniformly maintained at normal synthesis temperature, a gradual accumulation of carbon can take place so that an appreciable decrease in catalyst density and particle size may be observed over a two-week period. Stratification of the catalyst may result, and eventually catalyst may be lost through "carry-over."

The formation of high molecular weight wax accompanying the synthesis of liquid fuel hydrocarbons can be another serious problem, particularly in fluid operation. A study of the product distribution in the Fischer-Tropsch process suggests that certain thermodynamic equilibria are operative which determine the relative amounts of the normal paraffins of each molecular weight range, the relative amounts of the different normal 1-olefins, the degree of branching, etc. The complete picture is quite complex, and all the details have not yet been developed. It is clear, however, that the operation of these equilibria impose certain limitations on the flexibility of the process. Generally speaking, the modern Fischer-Tropsch process yields a disproportionately large amount of gaseous hydrocarbons, the average molecular weight of a typical total hydrocarbon product corresponding to between C_2 and C_3. As much as 25 per cent of the gasoline yield from fluid operation may be realized from secondary polymerization of propylene and the butenes produced in the process. At the other end of the product range are found relatively small amounts of extremely high molecular weight wax paraffins. On account of the equilibria involved, it is impossible to reduce the gas yield, through changes in operating conditions, without simultaneously increasing the wax yield. Likewise, the ratio of diesel fuel to gasoline, normally about 1:6, cannot be increased without a corresponding increase in wax. Only relatively small amounts of wax deposited on the catalyst in fluid operation are sufficient to cause catalyst agglomeration and incomplete fluidization with consequent localized overheating and carbon deposition. This sequence of effects is avoided in one type of fluid operation by periodically interrupting the flow of synthesis gas to the reactor and flushing with hydrogen.

From what has been said, it may be concluded that the wax problem is

Synthetic oil plant at Baton Rouge, Louisiana.



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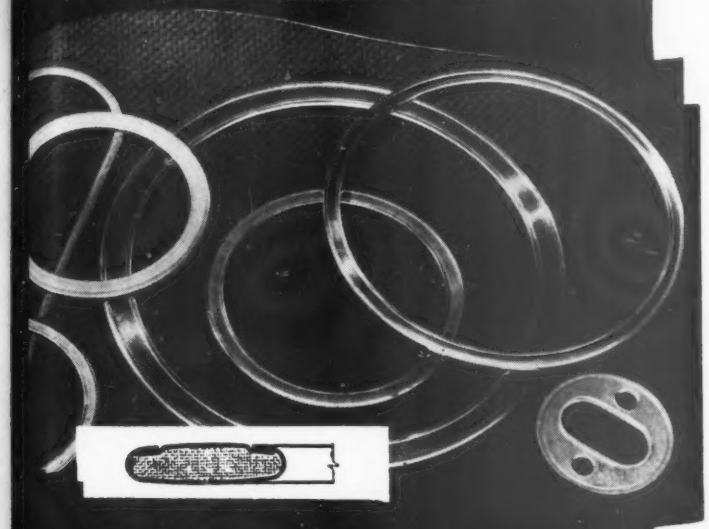

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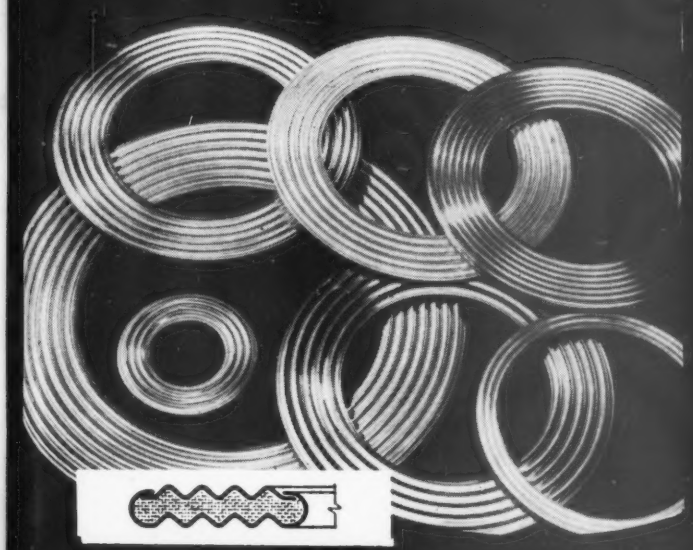

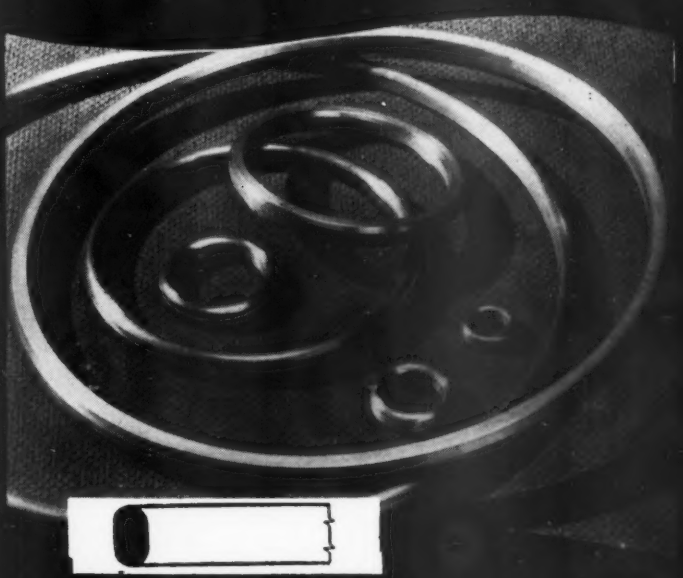

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an unavoidable consequence of thermodynamics. This is true, but the whole problem of product distribution is much more complicated than we have pictured it and much more intimately related to the actual chemical mechanism of the process. For example it is frequently observed that during continuous Fischer-Tropsch operation a gradual change in the molecular weight of the heavier products occurs as the run progresses although the total conversion may remain unchanged. Qualitatively, this might be explained by a gradual change in the effective reaction temperature level. It is difficult to evaluate this explanation because no one has ever measured the true catalyst surface temperature or followed its changes during the course of reaction. It is perhaps reasonable to expect, however, that a fresh catalyst might operate at somewhat higher temperatures than a partially spent catalyst.

If one studies the bulk composition of the catalyst as a function of throughput, interesting parallel changes are revealed. Starting with a catalyst which is essentially metallic iron, it is observed that the iron is gradually transformed to magnetite (Fe_3O_4). This, in turn, is displaced by carbides and, finally, by amorphous carbon. It may seem strange that iron should be oxidized to magnetite in the presence of reducing gases such as carbon monoxide and hydrogen. But water is the predominant single product in the synthesis of hydrocarbons, amounting in some cases to 2 lbs. per lb. of C_3 + hydrocarbons, and a sufficiently high partial pressure of steam is always present in the recycle gas to effect this conversion.

These bulk composition studies disclose very little information about the true surface composition of the catalyst which is not only much more difficult to analyze but also much more important to a fundamental understanding of the process. It is likely that similar composition changes occur on the catalyst surface, and it is interesting to speculate that the relative amounts of the different surface compounds present may largely determine whether a unit produces high octane number gasoline, heavy waxes or amorphous carbon.

Until we know more about the catalysis mechanism of the Fischer-Tropsch process, we cannot expect to arrive at optimum conditions for the synthesis.

The Fischer-Tropsch process is characterized not only by its abnormal volume shrinkage but also by its loss of heat value. If we start with 100 Btu's in the form of coal or natural gas, we make synthesis gas with about 80 Btu's. When this is put through the reactor, we come out with about 50 Btu's of total marketable liquid fuel. The motor fuel itself has only about 40 Btu's. This would not be too serious if the heat generated by the two exothermic reactions (manufacture of synthesis gas and conversion of synthesis gas to liquid fuels) could be utilized in some profitable manner instead of being used in the Fischer-Tropsch operation. Over two-thirds of the energy required comes as by-product steam from the process units and the remainder can be obtained from by-product fuel gas; but all of this energy must be "plowed back" into the process to take care of the vast amount of pumping, compressing, and heating required. This in turn results in tremendous cooling water requirements. Estimates of cooling water evaporation which must be replaced with make-up cooling water have ranged from 29 to 36 gallons per gallon of Fischer-Tropsch liquid.

Now this is not an unsolvable problem, but it is of the utmost importance because of the scarcity of water in certain sections of the country, because of yield of synthetic fuel from coal or gas, and because of the bearing of the process upon conservation of fuel resources. Until some degree of success is attained in this direction, the process cannot be regarded as fundamentally sound.

Removal of the heat of the synthesis reaction also presents some problems. If this heat is not removed as rapidly as generated, the synthesis reaction tends to run away and get out of control. The fluidized catalyst technique has been applied to this problem with considerable success, but the solution is not completely satisfactory because of the large amount

Coal gasification pilot plant of Pittsburgh Consolidation Coal Company at Library, Pennsylvania, designed and built in cooperation with Standard Oil Development Company. Purpose of plant is to study operability of fluidized coal gasification process to reach conclusions regarding costs and designs.

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of cooling surface that must be submerged within the catalyst bed. The volume of the catalyst bed and the amount of cooling surface required are determined by different factors, while certain physical aspects of the process equipment make them interdependent. The volume of the catalyst bed is, of course, fixed by the required conversion consistent with permissible linear and space velocities. On the other hand, the amount of cooling surface required is set by the heat generated. In certain instances it is something of a problem to incorporate enough cooling surface without having the cooling surface extend above the bed into the vapor region, under which conditions wax tends to form on the tubes.

The power requirements of the process are considerable. In the case of the partial combustion method of preparing synthesis gas from coal or natural gas, the manufacture of oxygen requires great quantities of power. Tonnage oxygen in the Fischer-Tropsch process costs just as much as tonnage oxygen in any other process, because energy is consumed which could otherwise be sold or put to other uses. Well-informed present opinion is that the cost of tonnage oxygen may be around 15 cents per thousand cubic feet. This would make the oxygen cost alone amount to over $1.25 per bbl (3 cents per gallon) of synthetic motor fuel. In the case of natural gas it is possible to avoid many technical problems by the use of the methane-steam process. In the case of coal there appears to be no clear alternative to partial combustion, although very little is yet known about processes of coal gasification.

Another considerable power requirement is for compression of the large volume of gas to around 20 atmospheres and the passage of this gas through the reactors. It has, perhaps, not been sufficiently emphasized that the fluidized catalyst bed is a relatively high consumer of power because the pressure drop must be sufficiently great to support the whole weight of the catalyst bed through which all of the fresh feed and recycle gas (which amounts to about three times the fresh feed) must be passed.

From an economic standpoint, it is essential to develop processes of synthesis which do not depend upon credits for by-products which have limited markets. The oxygenated compounds formed along with the hydrocarbons in the Fischer-Tropsch process offer attractive possibilities as chemicals on a relatively small scale. But while ten 7000 bbl per day synthesis plants would produce less than 3 per cent of the country's motor fuel, the by-product ethyl alcohol would amount to almost 100,000,000 gal per year, or about half the estimated demand for this material. Of course, it would take far less than this amount to glut the ethyl alcohol market, especially since appreciable quantities of compounds such as acetaldehyde and acetic acid, which are presently made from ethyl alcohol, would be formed along with it in the Fischer-Tropsch process.

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The Texas Company's Montebello, California, hydrocarbon synthesis pilot unit.

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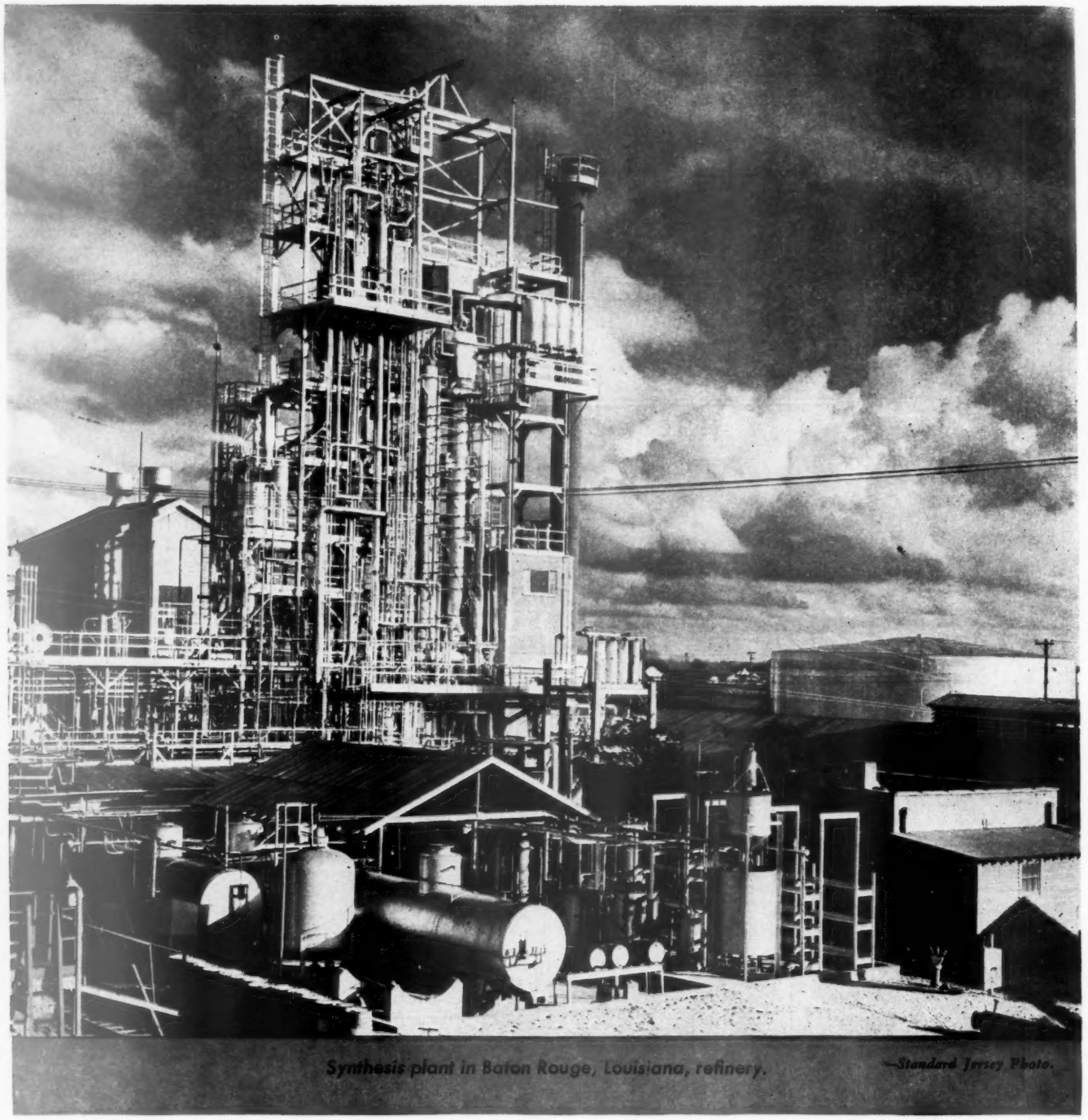


Synthesis plant in Baton Rouge, Louisiana, refinery. —*Standard Jersey Photo.*

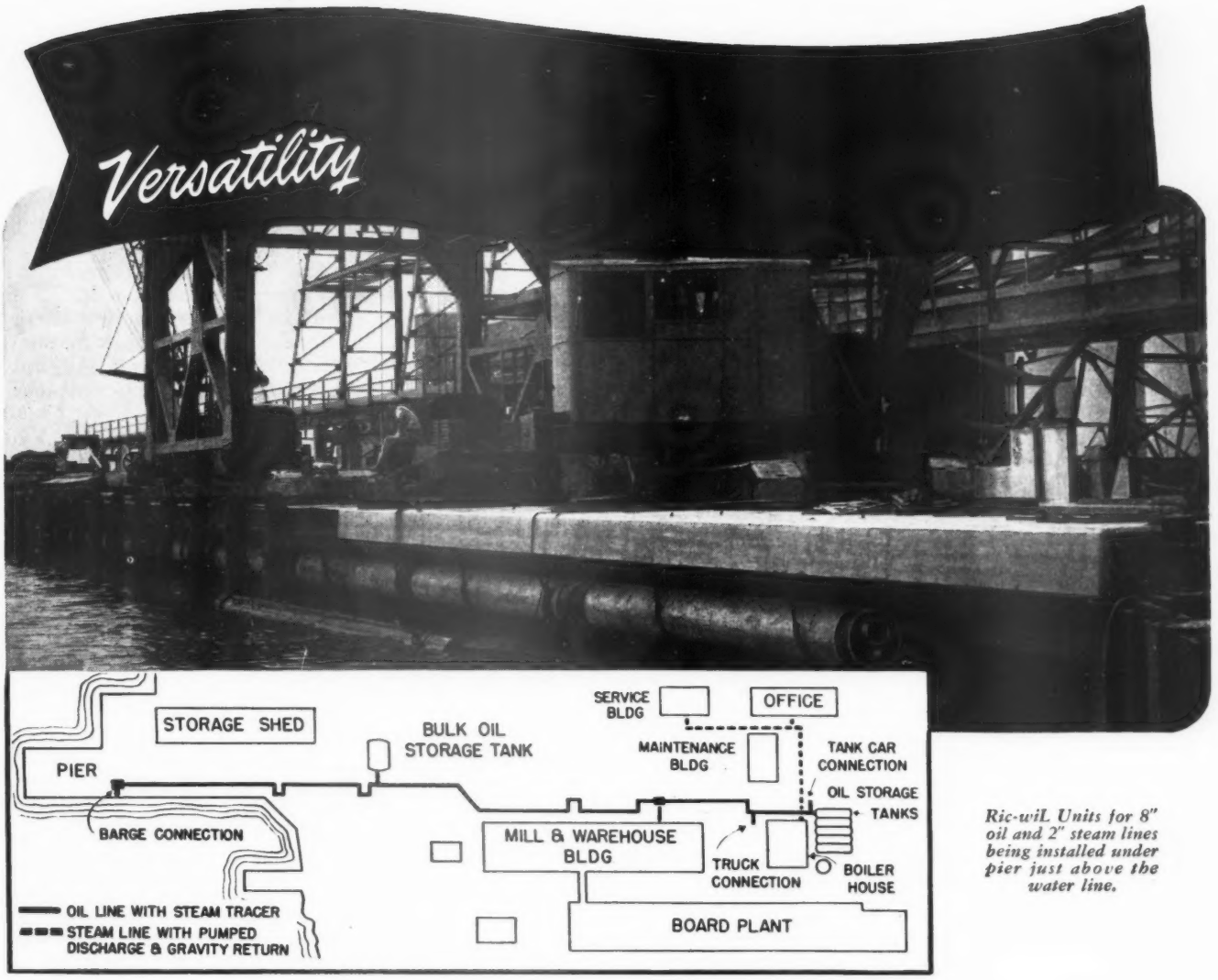
compounds may be difficult since stream pollution laws require their removal from plant waste water, and they are present in such dilute water solution that they cannot be burned without undergoing concentration.

These are a few of the problems that await solution. We believe it is safe to predict that the future processes of conversion will be quite different from any presently proposed process. The mechanism of catalysis will be better understood, which will mean a higher proportion of on-stream time, a longer catalyst life, and greater flexibility with regard to product distribution. Space velocities may be very much greater (perhaps tenfold), which will cut down investment in equipment. By-product production will be limited to the quantities that can be absorbed by markets. This all sounds more like a list of research objectives than a prediction of accomplishments, but the two can sometimes become synonymous when the urgency is great. In this case the importance of reaching such objectives cannot be exaggerated.

We venture to suggest that too much of the research on the synthesis of liquid fuels from coal (and gas) has remained in the grooves made by German technologists, and that the most constructive thing we can do in this period of development is to become fully aware of the characteristic difficulties of the conventional process patterns. We have applied magnificent chemical engineering development to possibly inferior processes whose faults are inherent instead of stressing the search for basically new process conceptions which may be free from these faults. American chemical engineering is without equal among the nations of the earth. We hope that future events may prove that our rank in fundamental research and originality of approach is equally high.

* * *

Versatility



Ric-wiL Units for 8" oil and 2" steam lines being installed under pier just above the water line.

AT THE GREAT NEW PLANT of the National Gypsum Company at Baltimore Ric-wiL Insulated Piping was specified for lines carrying fuel oil from ship to storage tanks, boiler house and mill, and steam from boiler house to various plant structures. These oil and steam lines are typical examples of the adaptability of Ric-wiL Pipe Units to diversified uses and conditions, and the efficiency with which they will accommodate any required arrangement or combination of pipes.

The oil line shown in the diagram with its various branches comprises more than 1600 ft. of Ric-wiL Units with pipes insulated from the exterior but not from each other. Capable of carrying 800 gallons of oil per minute at 150°F., the line runs just above the water line under the pier, and continues underground as indicated. Welded connections are used throughout.

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Consulting Engineers: Hall, Turpin and Wachter, Baltimore
General Contractor: Baltimore Contractors, Baltimore

For more complete information on Ric-wiL systems write: The Ric-wiL Co., Dept. 14-A

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REPRESENTATIVES IN PRINCIPAL CITIES

Union Develops Shale Oil Retorting Method†

By HOMER REED and CLYDE BERG*

▸ **Summary.** The shale oil reserves of the United States are conservatively estimated to constitute over 100 billion barrels, of which almost 50 billion are recoverable in Colorado alone.[1] Union Oil Company is carrying on an extensive program to develop processes for retorting shale and refining the extracted oil.

Union has developed a continuous retort which, because of its unique counter-flow principle, eliminates the need for large quantities of cooling water and heat exchangers, thereby greatly reducing operating and capital costs. The development studies of this retort have progressed from a 2-ton per day pilot unit to a 50-ton per day semi-commercial unit. It is expected that commercial units will reach the capacity of 4000 tons per day of oil shale.

Oil recoveries in the kiln operation consistently exceed the assay value for the oil content of the shale. Considerable quantities of fuel gas are produced.

▸ **History.** The production of oil from shale antedates the production of oil from wells by about 20 years. When the latter production was developed, there were about 50 plants in the United States producing oil from shale, and many similar plants in Europe, notably in Scotland and France. This industry was unable to compete with the oil from wells. Those few plants that survived before 1940 were located in Scotland, Estonia, and Manchuria.

The shale kilns employed in the Scottish retorting operations are essentially externally fired vertical kilns and have been described widely in the literature. Manchurian shale kilns are a modification of gas producer construction wherein the actual retorting is effected by the circulation of a mixture of producer gas and shale off-gas. Estonian shale retorting features the so-called Kivioli tunnel oven wherein shale is retorted when carried in steel cars through a high-temperature tunnel. During the second world war a variety of shale retorts were developed in Germany and France. Exploitation of this source of synthetic fuel was particularly intensive in Germany during the latter stages of the war.

In the United States some recent thought and development effort has been given to the application of TCC and fluid cracking techniques to the retorting of shale.

▸ **General considerations leading to the development of the Union Oil retort.** The development of the Union Oil Company retort was carried out in conjunction with economic studies of a variety of existing shale retorting methods. Generally speaking, the existing methods of shale retorting resulted in operating costs which eliminated the possibility of their being employed when viewed from the standpoint of producing oil competitive with existing crude oil prices. The factor which caused most prior shale retorting methods to fail from this economic aspect was that of capital investment. Large quantities of shale must be processed in commercial production of shale oil, and the quantities of heat which must be exchanged are consequently large. Facilities to effect transfer of the quantities of heat involved through exchanger surfaces or by means of re-circulating gas streams involve large investments. These investments were found to range as high as $1500 to $3000 per bbl. Associated with this high investment aspect, most shale retorting processes incur a large utility requirement, necessitating tremendous quantities of cooling water, and frequently utilize all of the gas production from retorting to supply fuel for operation. The Union Oil retorting process, because of its simplicity, will be relatively low in capital cost, and furthermore the utility requirements are virtually eliminated, no cooling water or supplementary fuel being required in the retorting operation.

▸ **Details of Union Oil retort.** This unit employs an underfeed principle with countercurrent flow of shale and air. The ash and clinkers are removed overhead and the oil drains out the bottom of the unit. The oil is distilled by downward flow of heat furnished by the combustion of the residual carbon on the shale clinker at top of the kiln. The heat available for other purposes from the combustion of the stack gases is equivalent to 40 to 50

FIG. 1. Two-ton per day shale unit.

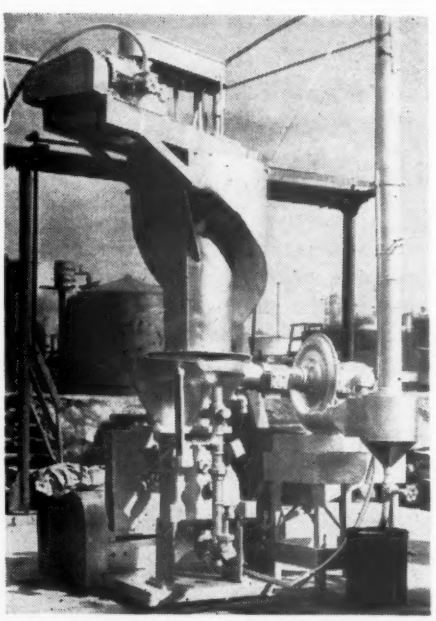
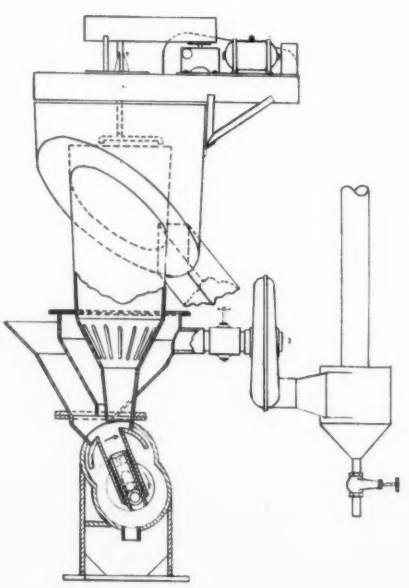


FIG. 2. Diagram of shale kiln.



†Contributed by the Petroleum Division for presentation at the Petroleum Mechanical Engineering Conference, Amarillo, Texas, October 3-6, 1948, of The American Society of Mechanical Engineers.

*Both of Union Oil Company of California, Los Angeles.

[1]U. S. Department of the Interior, Bureau of Mines Bulletin 415.

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Fig. 1460—125-pound Iron Body Bronze Mounted or All Iron "Master Pilot" Gate Valve.

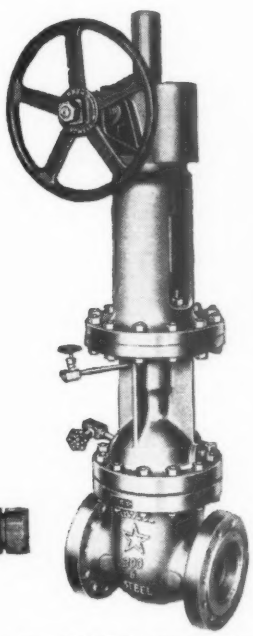


Fig. 3003 S. S. Mod. — Class 300-pound Cast Alloy Steel Gate Valve for ultra high temperatures as in T. C. C. Has drain valves in stuffing box and bonnet. Also cooling fins to dissipate the heat. Gear operated.

Fig. 1793—Large 125-pound Iron Body Bronze Mounted O.S.& Y. Gate Valve.

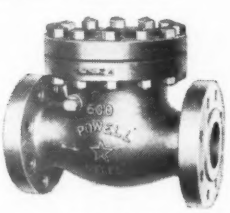


Fig. 6061—Class 600-pound Cast Steel Swing Check Valve.

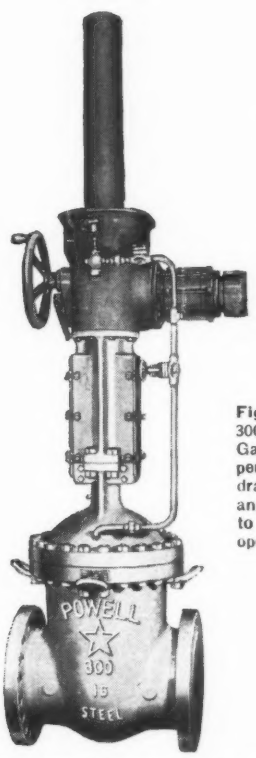


Fig. 3023—Class 300-pound Cast Alloy Steel Gate Valve with automatic steam sealing mechanism. Has explosion proof electric motor operator.

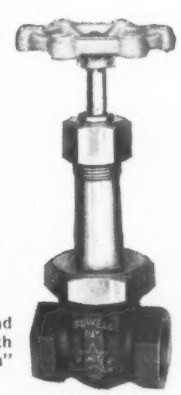


Fig. 375 — 200 - pound Bronze Gate Valve with renewable "Powellium" nickel-bronze disc.

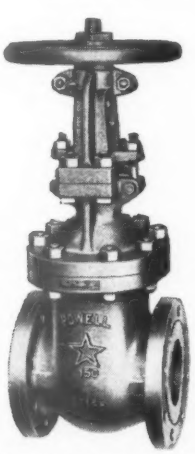


Fig. 1503—Class 150-pound Cast Steel O.S.& Y. Gate Valve.

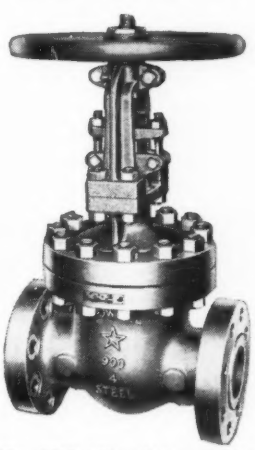


Fig. 9003—Class 900-pound Cast Steel O.S.& Y. Gate Valve.

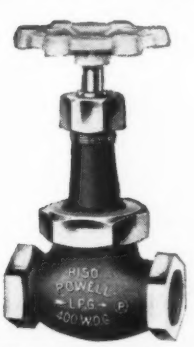


Fig. 8150—Bronze L.P.G. Globe Valve with special composition disc. Write for descriptive circular 8-48B.

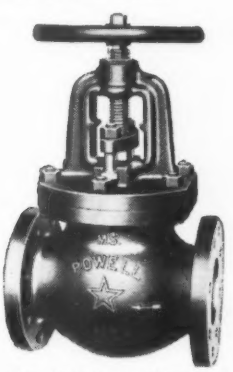


Fig. 241—Large 125-pound Iron Body Bronze Mounted O.S.& Y. Globe Valve.

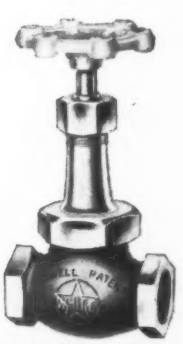


Fig. 1708—200-pound Bronze Globe Valve with renewable stainless steel seat and regrindable, renewable "Powellium" nickel-bronze disc.

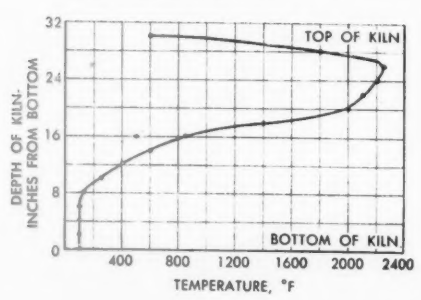
POWELL VALVES

per cent of the fuel value of the shale oil. Very efficient heat exchange is obtained in the unit by direct contact. The incoming air is preheated by the spent clinker and the products of distillation are condensed on the cool, incoming shale. The shale clinker is discharged hot because of the excess of heat available from combustion of residual carbon on the clinker.

The 2-ton per day pilot plant pictured in Fig. 1 and illustrated in Fig. 2 consists of a cylindrical kiln with an underfeed mechanism, permitting the movement of granular shale upward through the unit with an overflow at the top where the clinker is removed by a scraping mechanism and falls into an ash disposal chute. The sections of the kiln expand gradually upward, minimizing restriction to upward movement. The retorting section in this unit is 30 in. high and 12 in. in diam. at the bottom. A conical slotted section below the retorting section effects the separation of the oil and gas from the incoming shale. A collector surrounds this section, and the gas is drawn from this through a blower and oil collector. It will be noted that the feeding mechanism is so constructed that any fines that fall through the grate return to the feeding piston and are re-introduced so that the gas and oil collecting housing cannot suffer from plugging due to accumulation of fines. The feeding mechanism is filled with oil to a level just below that of the slot edges, providing a liquid seal which prevents the blower from pulling in air through the feed hopper. Between the kiln and the blower, there is a butterfly valve which controls the air drawn through the kiln. Discharge of the blower passes directly to the oil collection cyclone, where the liquid product is taken and the fuel gas is produced overhead.

The process occurring in the kiln retorting section may be divided into three zones. In the top zone heat exchange between incoming air and hot clinker leaving the unit is effected. In the lower portion of this top zone, combustion of the carbon residue on the clinker is effected, producing flue gas with a temperature near 2000 F. This flue gas progresses into the second zone, which may be termed the retorting zone, wherein the oil vapors are educted from the shale. The mixture of shale oil vapors and the flue gas progresses downward into the third zone, termed the condensation zone, where the incoming green shale is heated and the products of eduction are cooled and the oil condensed. The exit oil and gas from the kiln approach within 20-deg of the shale being charged. A graph of the typical temperature profile in the shale kiln is presented in Fig. 3.

FIG. 3. Typical temperature profile of two-ton a day shale kiln.



Operation of Union Oil retort. To put the kiln in operation it is filled with shale. The crankcase and gas around the disengaging section are filled with oil from the previous run. A layer of kindling wood is placed on top of the shale and ignited. The blower of the kiln is then started which draws the fire down through the shale bed, igniting the mass of shale. When it is observed that the top layer of shale has burned to a clinker, the feeding mechanism and the ash removal equipment are started. Oil production is normally obtained from the unit within ten to fifteen minutes after ignition.

Results of pilot plant operations are presented in Tables 1 and 2. It will be noted that in a typical operation charging the unit at a rate of 1.84 tons per day, 58.0 gal shale oil per ton of shale were produced, exceeding somewhat the retort analysis figure of 57.2 gal per ton. In this operation, 19,100 cu ft of 188 Btu content gas were produced per ton of shale and 0.58 tons of ash were produced per ton of shale. The shale oil produced by the unit had a gravity of 21.6° API and a sulphur content of 1.26 per cent. The analysis of the gas produced is given in Table 3.

An appreciable quantity of nitrogen bases is present in this product. The sulphur distribution is somewhat unusual in that the highest content of sulphur is found in the lighter fractions of the stock.

Description of 50-ton per day semi-commercial unit. The 50-ton per day semi-commercial shale kiln is pictured in Fig. 4 and the assembly detail drawings presented in Fig. 5. The over-all design of this large unit parallels closely that of the smaller unit. However, the feeding mechanism is actuated hydraulically, which provides a maximum of flexibility and control of feeding action and an economical construction for large-size units. The ash removal mechanism is also driven by hydraulic mechanism. The large shale kiln employs a finned retorting section with cowling to direct an air flow over the fins. A secondary stack draws the air through this cowling section. Cooling of the shell is designed to effect a maximum metal temperature of 750 F at the burning zone. The gas flow through the kiln proper is provided by means of a Type W Roto-Clone. An Ultrasonic mist agglomeration unit processes the gas leaving the Roto-Clone to recover mist which carries through the preceding oil collecting unit. The

TABLE I. Typical pilot shale kiln operation. Operation on 55 gal/ton shale.

Shale	
Charge rate, tons/day	1.84
Oil content by retort, gal/ton	57.2
Oil	
Production, bbl/day	2.50
bbl/ton shale	1.36
Recovery, per cent oil by retort	102
Gas	
Production, MCF/day	26.0
MCF/ton shale	19.1
Heat content, Btu/cu ft	188

TABLE II. Survey of shale oil. Operation on 55 gal/ton shale.

Shale oil	
Gravity, API at 60 F	21.6
Water by distillation	0.2
Vis. Say. Univ. at 100 F sec	113
Sulphur, per cent	1.26

Refining crude distillation

Material	API 60 F	Per cent dry basis
Gasoline—410 F e.p.	44.1	11.2
Gas oil—41 Vis. Say. Univ. at 100 F	29.2	27.9
Residuum	15.1	60.3
Loss		0.6
Total		100.0

Gasoline	
Gravity, API at 60 F	44.1
Sulphur, per cent	1.15

Initial	10%	20%	30%	40%	50%	60%	70%
220	301	318	330	340	350	360	370

Initial	80%	90%	95%	Max.	Rec.	ABP
220	380	392	401	412	985	341.4

Gas oil	
Gravity, API at 60 F	29.2
Vis. Say. Univ. at 100 F sec	40.6
Upper pour point, F	5.0
Sulphur, per cent	1.14

Initial	10%	20%	30%	40%	50%	60%	70%
435	502	510	526	540	554	570	587

Initial	80%	90%	95%	Max.	Rec.	ABP
435	608	630	647	676	980	558.0

Residuum	
Gravity, API at 60 F	15.1
Vis. Say. Furol at 122 F sec	95
Flash, COC F	445
Sulphur, per cent	1.07

TABLE 3. Analysis of gas from shale kiln. Operation on 55 gal/ton shale.

	Mol per cent
Hydrogen	3.9
Nitrogen	57.5
Air	6.0
Carbon monoxide	11.0
Carbon dioxide	13.3
Hydrogen sulphide	0.4
Methane	3.3
Ethane	1.7
Propane	1.6
Butanes	1.0
Pentanes	0.3
Total	100.0
Specific gravity	1.000
Gross heating value, Btu/CF	188

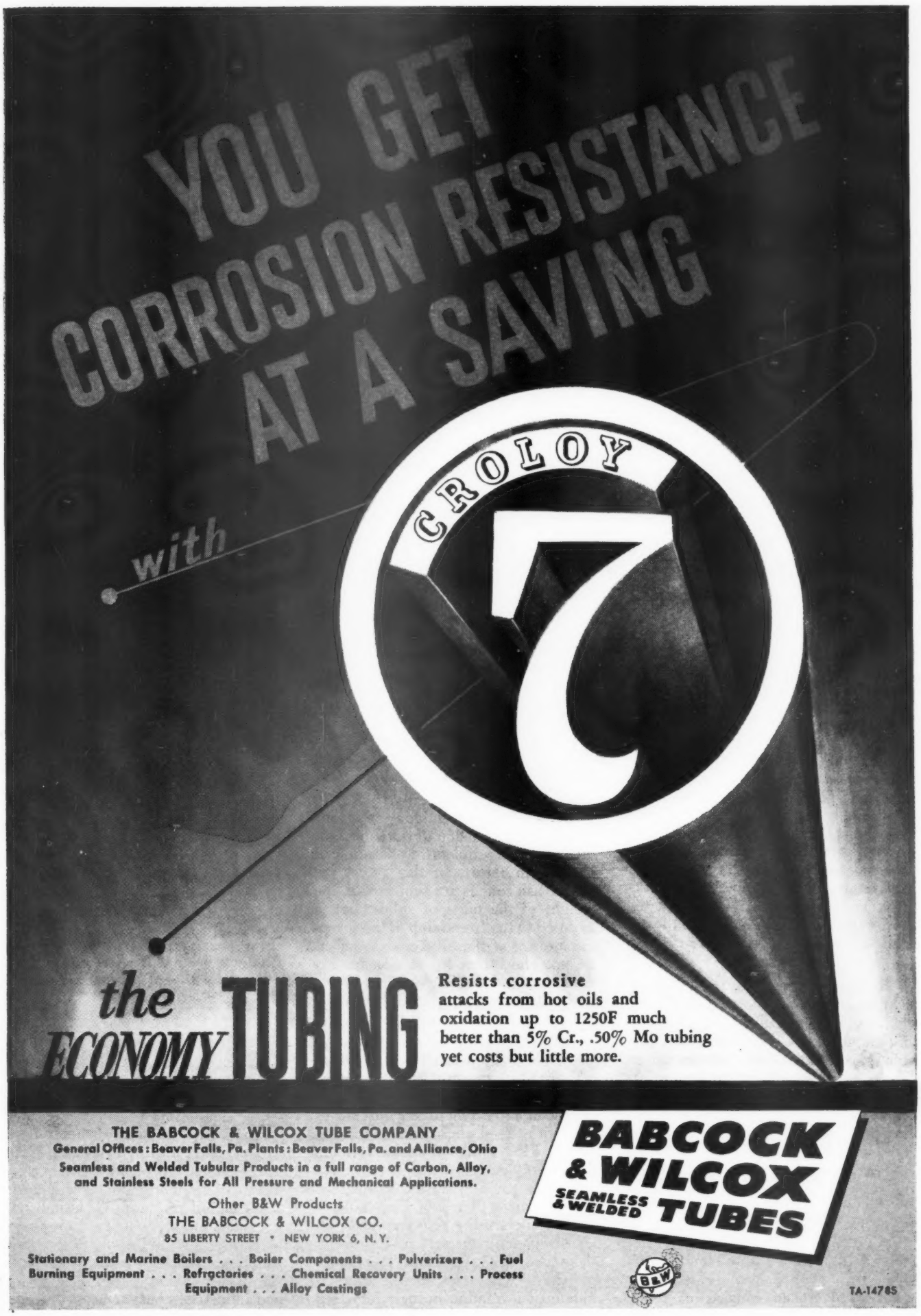

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FIG. 4. Fifty-ton per day unit.

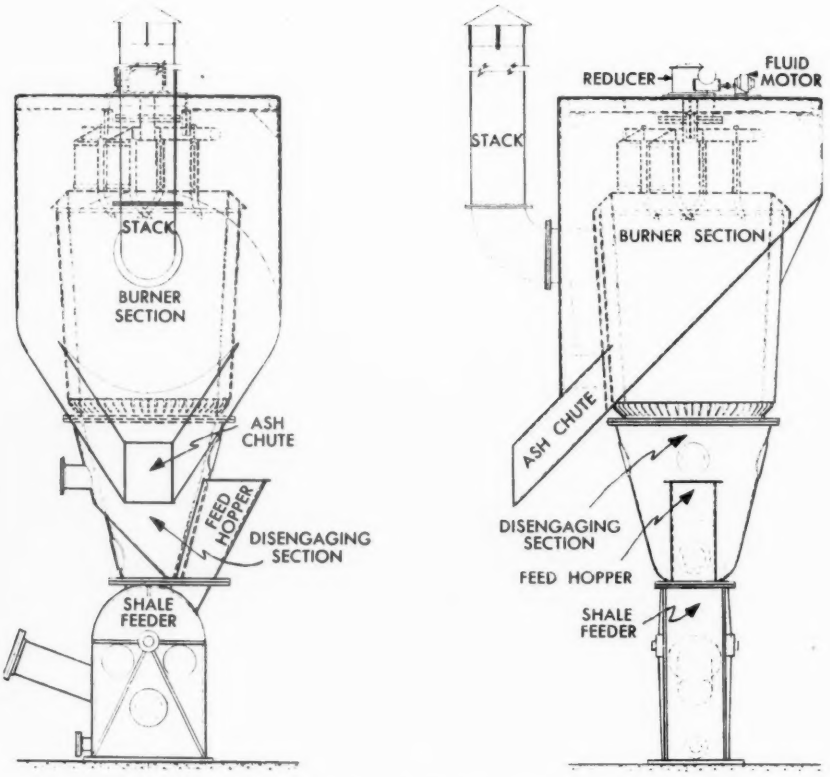


FIG. 5. Fifty-ton shale kiln elevations.

retorting section of this kiln is 7 ft high and 4 ft in diam at the lower end and expands to 5 ft in diam at the top. The disengaging grate in the unit is similar to that of the smaller plant and has automatic fines removal from the collector section Operation of the kiln is entirely automatic. Flow of air through the unit is controlled by an automatic flow controller actuated by an orifice located at the outlet of the Roto-Clone. A temperature controller, actuated by thermocouples located in the shell of the retort, maintains the burning section approximately 2 ft below the top of the kiln by control of the oil flow to the feeding mechanism.

Retorting characteristics of various shales. Retorting characteristics of shales of different grades of oil content from the Green River formation vary widely. Thirty-gallon shale as produced in the Bureau of Mines demonstration quarry operations exhibits very little fusion in being processed in the Union retort, and the particles of shale discharged from the kiln retain the same general physical dimensions as the original shale particles entering the unit. On the other hand, shale on the order of fifty to fifty-five gallons per ton is characterized by a semi-plastic condition in the burning zone, and the clinker discharged overhead consists of semi-fused agglomerates which have been rolled into lumps by the overhead ash discharging mechanism. Seventy-gallon shale exhibits even a more plastic condition in the burning zone, and the ash discharge on operation of this material is very definitely clinkered and exhibits little resemblance to original particles charged to the unit.

Unlike the conventional retort or gasifying kiln, fusion of the ash is not considered a problem in operation of the Union retort. In this retort the plastic ash zone is not subjected to the weight of the mass of solids, but is exposed to the free action of the scraping prongs of the ash removal mechanism. The forces for motion far exceed those of the conventional retort where gravity provides the motivating power for downward motion.

In the retorting of shales, an appreciable portion of the oil produced leaves the unit as a mist in the gases drawn from the base of the unit. The character and extent of this mist varies also with the grade of shale being retorted. Fifty to 55-gal shale produces an effluent gas mixture containing a relatively small quantity of mist of large particle diameter. This mist is fairly effectively agglomerated on simply passing through a blower by the action of the impeller. Thirty and seventy-gallon shales exhibit appreciable mist formation in their retorting operation, and particles of the mist are of a relatively small diameter, necessitating the use of special mist agglomeration equipment, such as an Ultrasonic or Cottrell unit.

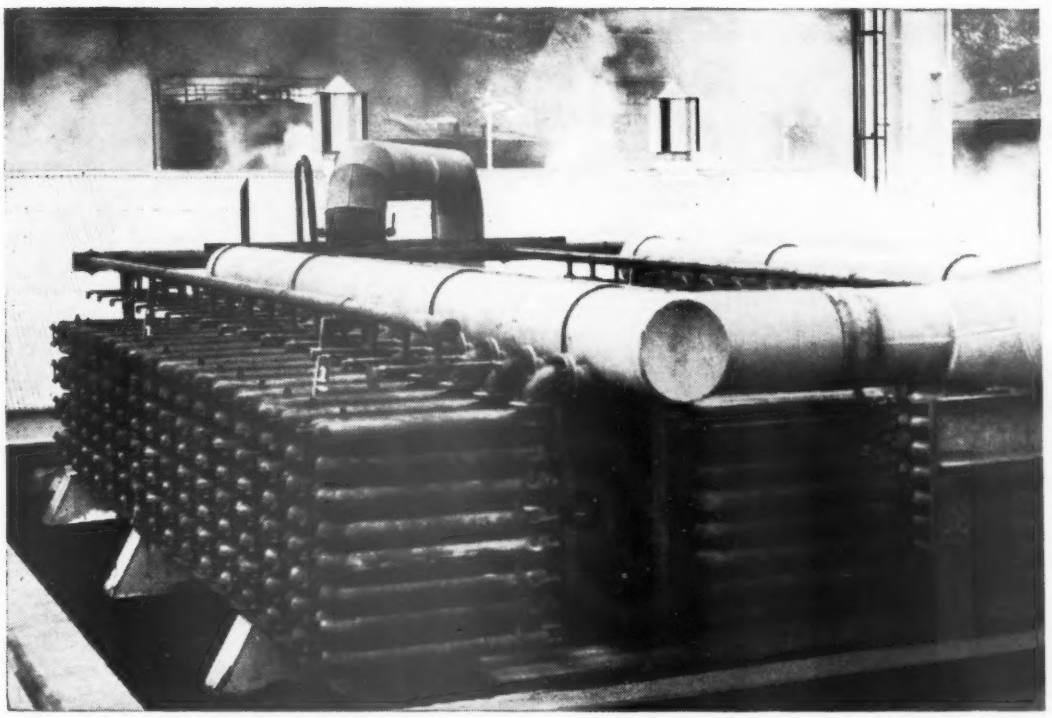
Products from retorting 140,000 tons of typical oil shale. Based on the retorting characteristics of shale from the Bureau of Mines, Rifle, Colorado, demonstration mine, the products that would be derived from retorting 140,000 tons of 30-gal per ton oil shale have been estimated. These quantities are tabulated below.

Products derived from retorting 140,000 tons 30 gal per ton oil shale

		Gross heat of combustion, MMM Btu
Shale oil, bbl/day	100,000	623
Ash, tons/day	80,700	..
Fuel gas, MSCF/day (gross heating value—79 Btu/SCF)	3,850,000	304

The energy content of the fuel gas produced in retorting is very considerable, amounting to 48.9 per cent of the total thermal energy available in the shale oil produced. This fuel will provide far more than the power necessary for mining operations and would provide opportunity for considerable outside power generation and industrial operations. * * *

FOR *Versatility*



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More Propane for Less Money*

By Z. C. AMBROSE†

IN the early days of the natural gasoline industry, everything that could be recovered from natural gas and held in pressure storage, even at low temperatures, was considered and marketed as natural gasoline. As production increased, certain restrictions were imposed upon the product, such as vapor pressure and specific gravity. In the early 1920's, a major step was made toward stabilization of the product, the first stabilizers being those designed and constructed by Carbide and Carbon Chemicals Corporation under the Rafferty patents. Shortly after this, the high pressure stabilizer that is now in common use was developed. In these early stabilizers, most of the propane and considerable quantities of the butanes were eliminated from the raw plant production, leaving a natural gasoline having a Reid vapor pressure of 12 to 26 lb.

For a number of years, the demand and price for the product did not warrant building plants to produce any more propane and butane than that which was recovered incidentally in the extraction of natural gasoline. As the LPG industry developed, plants were built for a higher propane recovery and, in a number of cases, old plants were remodeled to give better extraction efficiency.

The war brought the first really great demand for propane and butane. Butane was used in the production of alkylate and propane was cracked and used in the production of synthetic chemical products. The chemical industry, largely built up during the war, is at the present time demanding greater and greater quantities of butane and propane.

This discussion concerns particularly a method for increasing propane recovery in high pressure plants operating in gas condensate fields.

Whenever possible, process engineers use a light, low molecular weight absorption oil because it increases extraction efficiency per gallon of oil circulated and decreases costs. Installation and operation costs are lowered because the quantities of liquids handled, whether from rich gas or absorption oil, has more to do with sizing a plant than the volume of gas processed. As the oil circulation is increased, pumping costs, heat loads, and sizes of all vessels and other equipment are also increased. Until recently, high pressure gasoline plants were not afforded the benefits to be derived from using a low molecular weight oil because of retrograde evaporation. At high pressures, the light oil tends to revert to a gaseous state.

In recent years, experimental changes in plant design have been carried out at the Superior Oil Company's cycling plant in the Lake Creek field near Conroe, Texas.

This work, under the direction of S. F. Magor and R. A. Daugherty of the Superior Oil Company, appears to have pointed the way to a process whereby a low molecular weight absorption oil may be used in high pressure plants. The actual process design work of the Lake Creek plant was handled by A. J. L. Hutchinson, who was at that time head of the process department of The Fluor Corporation, and who is now with the Fish Engineering Corporation.

At the time the Lake Creek plant was built, the demand for propane was such that it was not considered desirable to make any special provision for its recovery. There was, however, a certain amount of refrigeration installed in the lean oil system so that the temperature could be lowered materially below that obtainable by water cooling. Soon after the plant was put into operation, there was an increased demand for propane; so, with the equipment at hand, an experimental program was undertaken to increase propane recovery.

The plant was originally designed to operate at 1500 psi absorber pressure, with an absorption oil having a mean molecular weight of approximately 230. To obtain more propane, the refrigeration unit was put into operation and some improvement in overall recovery was experienced, but not any more than would be expected from temperature reduction of the absorption medium. It was observed that when the temperatures were dropped, the loss of absorber oil was decreased. This led to the thought that with a lower temperature in the absorber, the molecular weight of the absorption oil might be reduced. With this in mind, the temperature was further reduced and the mean molecular weight of the oil was likewise lowered. The oil temperature was finally reduced until trouble was encountered because of hydrates forming in the absorbers.

Equipment was installed to dehydrate the gas ahead of the main absorbers and the low pressure still was converted from steam stripping to stripping with direct heat. It was then possible to operate with a lean oil temperature of 60F using an oil having a mean molecular weight of 155. With this temperature and molecular weight, the oil losses in the plant were substantially the same as when using 230 mean molecular weight oil at a temperature of 90F. As the plant was operating at a pressure of 2500 psi, the reduced temperature did not add appreciably to the propane recovery, but it did allow the mol weight of the absorption oil to be lowered from 230 to 155, thereby increasing the molecular circulation by approximately 45 per cent. The combination of reduced temperature and lowered molecular weight effected a much greater overall recovery of propane, and substantially 100 per cent of all butane and heavier constituents.

A new plant, incorporating, in general, the basic features of this experimental work, has been designed by Fish Engineering Corporation for the Southwest Gas Producing Company, Inc., and W. C. Feazel.

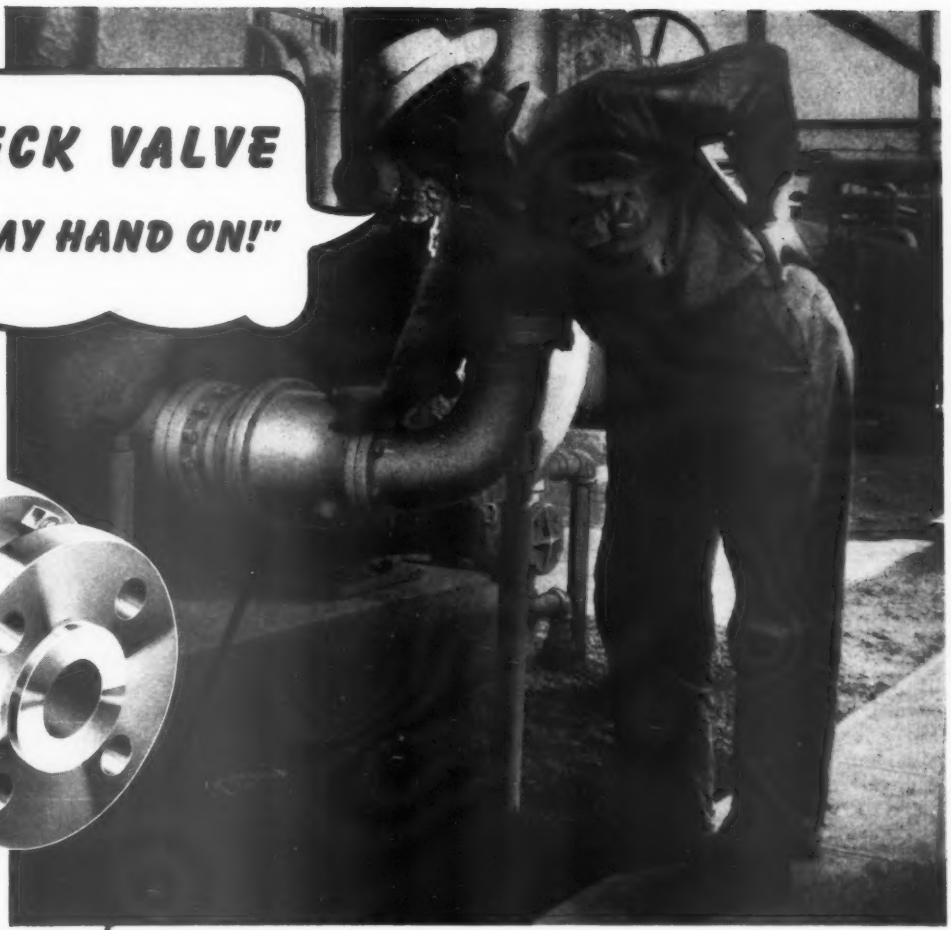
The plant, which is being constructed near Dubach, Louisiana, will have a capacity to process 90,000,000 cu ft of gas per day and recover 80 per cent of the propane. It will operate at 900 to 1000 psi. Wells supplying gas to the plant will have a flowing pressure of 2500 to 3000 psi and the gathering system pressure should be in the neighborhood of 1500 psi. It is estimated that after reduction to the plant operating pressure, the inlet gas will have a temperature not in excess of 90F. The gas will enter an inlet surge tank equipped with a long range level control to smooth out surges of flow through the plant. It will then be dehydrated by use of Florite contactors. Liquid leaving the inlet surge tank will be passed through a filter to remove entrained water. The dehydrated gas and "dry" liquid will then be commingled and cooled to approximately 60F by propane refrigeration. The distillate will be separated and passed to a distillate fractionating system, while the gas enters the main absorbers. The absorption oil desired will be a light kerosine cut having a mean mol weight of 155 and a gravity of about 49 API. Chilling the absorption oil to 60F is expected to reduce retrograde vaporization to a minimum. Lower temperatures in the absorber will also afford a certain amount of selective absorption. Smaller quantities of methane and ethane will be absorbed in proportion to the amount of propane. An examination of "vaporization equilibrium constant" curves reveals that the drop in temperature has much more effect on the "K" value of propane than on that of methane and ethane. This is no trivial factor, for getting rid of fixed gases is an expensive and troublesome problem in high propane extraction.

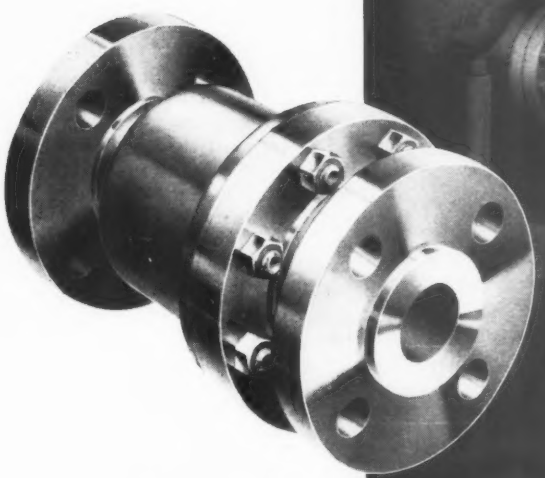
Dehydrating the gas before it enters the absorbers should aid in preventing corrosion throughout the plant. This is particularly important, for gas in this field has a high carbon dioxide content. Removing the water will tend to prevent corrosive reactions.

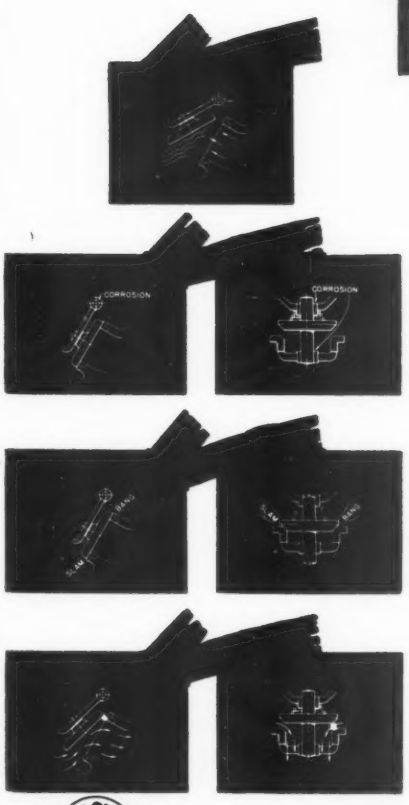
*Presented before Natural Gasoline Association of America, Annual Meeting, Fort Worth, Texas, March 24-26, 1948.

†Vice president, Southwest Gas Producing Company, Inc., Monroe, Louisiana.

"BEST CHECK VALVE I EVER LAID MY HAND ON!"







* So says the Head Shift Operator of La Gloria Corporation at Falfurrias, Texas

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The distillate fractionating system will yield naphtha overhead, kerosine as a side cut, and gas oil as a bottom product. The distillation unit handling rich oil from the absorbers will yield propane, mixed butanes, and natural gasoline having a Reid vapor pressure of 12 to 30 lb. By making the two products, natural gasoline and naphtha, full advantage of all market conditions can be realized. Should octane requirements necessitate the production of finished products having a wide differential between the Research and ASTM number, the naphtha can be reformed and blended with natural gasoline to produce the desired specification of motor fuel. In this way, the product can compete favorably with refinery gasolines.

Rich oil from the absorption system enters a high pressure still operating at 155 psig. A preheater ahead of this still raises the oil to a temperature of 390F. Only sufficient live steam is introduced into the high pressure still to strip the oil of gasoline having an end point of approximately 225F. The partially stripped oil then enters a low pressure still operating at nearly atmospheric pressure. Because of the use of a light absorption oil and partial stripping in the high pressure still, the oil can be completely stripped at this point without the use of live steam agitation. This is accomplished by using a reboiler on the base of the low pressure still which raises the temperature to about 410F. The only live steam that comes in contact with the lean absorption oil is that used for agitation in the high pressure still, and it will be distilled off before the lean oil reaches the absorbers.

The plant is unique in that it will have no direct-fired heaters on the rich oil stream. The design of most plants requires direct-fired heaters, and quite often the oil is heated to a temperature higher than necessary. In some cases, hot oil enters the still at a temperature 30 or 40 deg above the bottom temperature. This means that an excess amount of reflux is being used to cool the tower thereby increasing the cooling tower load. Certainly the elimination of direct-fired heaters is desirable for safety.

The basic features and advantages of the new type plant design are summarized as follows:

1. The wet gas will be dehydrated before it enters the absorbers, thereby allowing both the gas and absorption oil to be cooled by refrigeration far below the temperatures at which hydrates would ordinarily form.

2. This low temperature permits the use of a very light, low molecular weight absorption oil without serious loss due to retrograde evaporation.

3. The use of a low molecular weight oil, in turn, increases the propane extraction and at the same time it keeps the lean oil circulation to a minimum. When using the low molecular weight oil, only slightly more than one-half as much oil circulation is required.

4. Operating at lowered temperature permits selective absorption thus eliminating much of the troublesome fixed gases that are normally picked up.

5. Minimum oil circulation and partial elimination of fixed gases results in considerable savings because of decreased heating loads, sizes of vessels, pumps and other equipment. Overall savings in cost of installation will vary, of course, with capacity, richness of the gas, and other conditions. For our particular plant, the saving over conventional design is estimated to be about 15 per cent. In our opinion, savings considerably in excess of this amount can be made on future plants.

6. "Dry" distillation leaves the residue gas free of moisture and suitable for pipe line transmission. This permits dehydration to be done at the inlet of the plant.

7. Elimination of moisture from the absorber and residue gas system will tend to prevent corrosion in equipment.

8. There are no direct-fired heaters in the plant. All heating is done with steam although the heavier products have a boiling range in excess of those recovered in many high pressure gasoline plants.

It is understood that patent application has been made covering the combination: Dehydration ahead of the main absorbers, refrigeration of the oil and gas to the main absorbers, and the use of a low molecular weight oil in conjunction with "dry" distillation or some other method that might produce a dehydrated lean oil for absorption purposes. Fish Engineering Corporation has patent rights. ★ ★ ★

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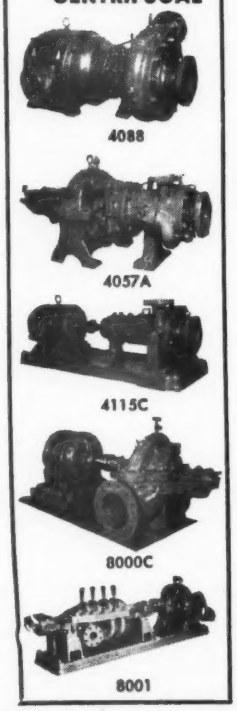

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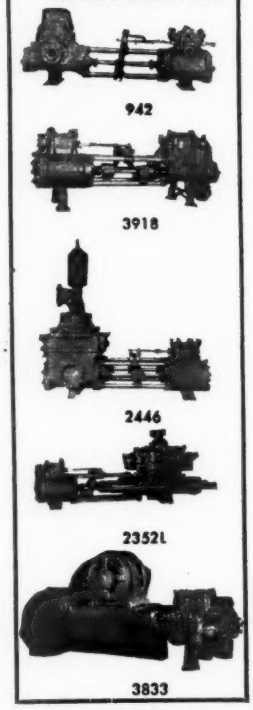

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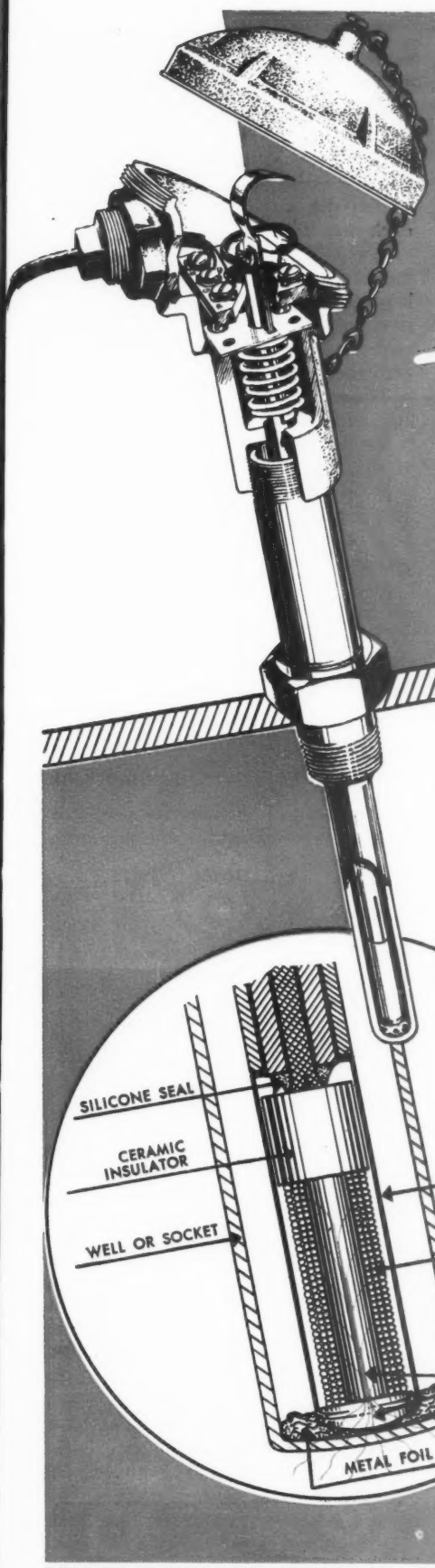

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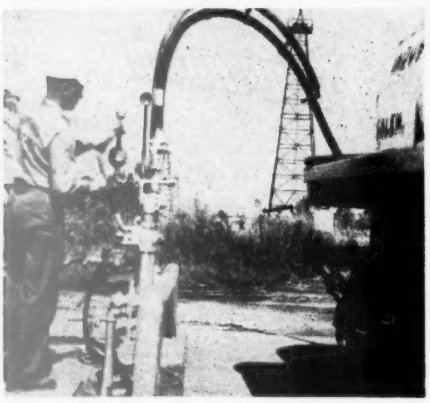
PLANT AIDS

LPG Loading Hose Protector

The pulsation of the loading pump transferring liquid products from storage to truck tanks invariably causes the hose to jump and bounce around with the result that wear and abrasion of the outer protective rubber surface is unavoidable, if the hose is allowed to lie unsupported. To support this loading hose and prevent damage, a support is made by using two-inch pipe attached to a suitable base and

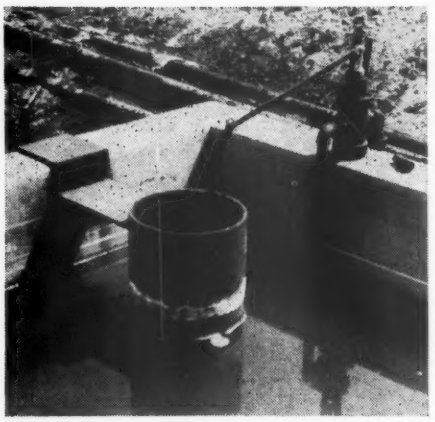


fitted with retainers at frequent intervals. A rise of 6-inch pipe is set in the concrete island supporting the loading equipment. The top of the riser is fitted with a plain collar, or coupling, from which the threads have been turned away to provide a plain sleeve. A swedge nipple, 6-inch by 2-inch is attached to a convenient length of 2-inch pipe previously bent in a long easy arc which supports the main section of the loading hose. Strap iron clamps are attached to both the hose and the support above any part of the equipment so that rubbing will be prevented.

Valve Float Cage

The ball float on the arm of a make-up valve feeding water into a tank or cooling tower basin takes a greater "beating" than is generally supposed. It can be damaged by wind blowing against it, floating planks accidentally dislodged and falling into the basin to interfere with its action, or it may be damaged with a shovel or rake when men clean the basin. To protect the float, a nipple is cut to the length required, depending upon the height of the tank, or basin wall and the level maintained in the tank or basin.

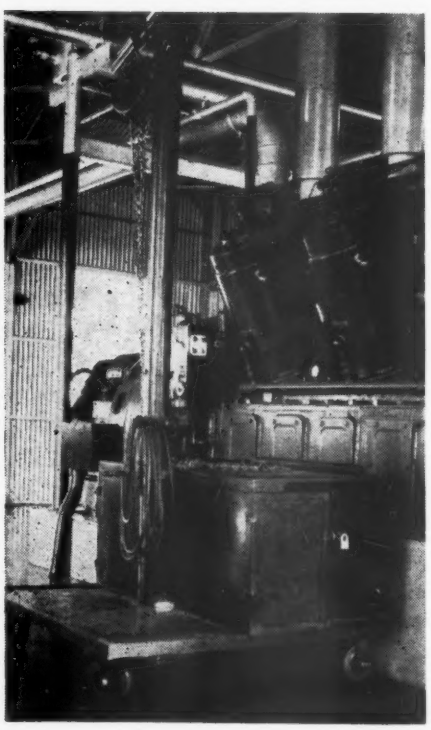
Twelve-in. pipe is sufficiently large to provide unimpeded action of the



float ball riding on the surface of the water and to clear the adjusting arm at any reasonable angle. The ball cage can be mounted by supporting it on the basin wall with a flat piece of tank steel, shaped to fit over the rim of the basin wall with a push fit. The horizontal extension welded to the pipe cage supports it rigidly around the float.

Cylinder and Piston Hoist

On engines where the layout prevents the use of a circular roof supported hoist track, a truck-mounted crane with attached hoist has been found to be ideal for servicing angle-type engines. The base for this unit is made of substantial steel bound at the

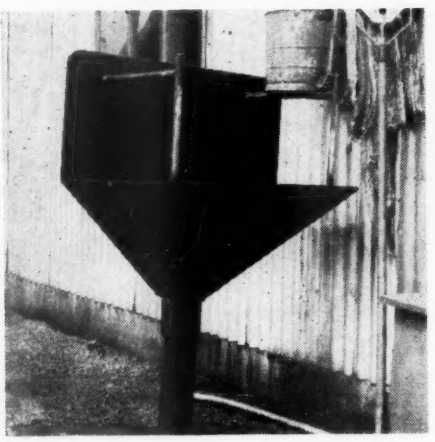


edges with angle iron, supported at each corner by heavy-duty rubber tired casters. At one side of the base is mounted a steel box with doors and trays for essential parts and tools, having a top heavy enough to support any part of the engine removed with the crane and chain hoist.

The mast for the crane is a convenient length of 4-in. pipe welded both to the floor of the base and to one side of the tool box in a manner to prevent 'giving' when a load is applied. The crane is attached to the top of the mast with a bearing which permits 360 degree revolution so that a piston, cylinder head, or the individual cylinder itself can be removed and lowered without disconnecting the pulling sling. When in use, this tool is rolled against the foundation of the engine with the tool box nearest the unit.

Cleaning Solvent Disposal Sink

The disposal of solvents used for washing parts of equipment and mop-



ping oil from floors has always been a problem but is facilitated by a method developed so that any excess might be dumped for return to a slop tank, or skimmer pit.

A rectangular funnel attached to a 2-in. drain line is placed at a convenient location. A "bang board" at one side prevents spilling when a pail is emptied, while racks at each end provide hangers for mops and pails. The top of the disposal funnel is set at a convenient height so the clean-up man can easily pour the remaining kerosene or solvent from the pail with little effort. The material flows through the 2-in. line to the slop tank where it is recovered.

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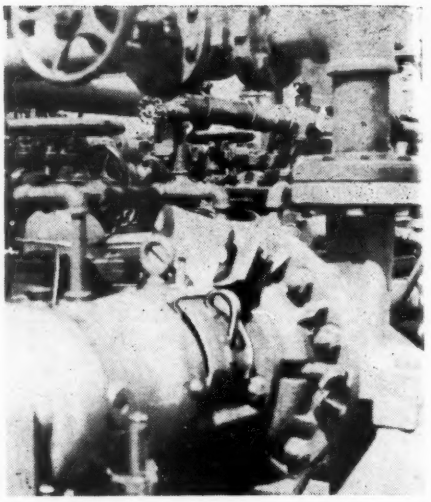
Caustic Melting System

Much of the labor and power required for handling drums of caustic can be eliminated by rearranging facilities for preparing solutions to treat natural gasolines and distillates. In this installation, the storage dock is built level with the floor height to match the average transport truck body so the drums as received can be rolled, or trucked readily, from vehicle to storage. A circular opening is cut in the floor of the dock, at one side, below which a solution tank is set on an adequate foundation approximately at ground level.

A screen, or support for the drums is made of heavy pipe arranged in the form of a grid heavy enough to support several drums. The grid is connected to a steam line to melt the solid material and arranged with four jets to melt four drums simultaneously. To load the grid, the head of the drum is removed so the container can be upended on the melting pipes by simply rolling the drum and tipping over the edge onto the grid. Pipe connections permit pumping the solution from the melting tank to tanks where treating compounds are made up in the usual manner.

Packing Gland Cover

Centrifugal pumps in the treating plant handle corrosive acids and alkalies that cause packing to 'spring a leak' with little or no advance notice. To prevent spraying the solution over surrounding equipment, and the operator when in that vicinity, a cover held in place with a spring steel clip can be made by the tinsmith in the refinery shops. A piece of thin sheet steel is cut as wide and slightly longer than the opening in the pump body, and formed to match the contour of the pump. The lower end has a lug tack-welded on the outside as a stop to prevent that end from passing a certain point when inserted.



On the inside of the upper end is a strip of spring steel rolled at one end and attached with rivets or tack-welded so that, when the cover is pressed sharply against the opening, this clip will snap down and into the opening as a retainer, similar to the fingers of a hub-cap spring. A "D" handle riveted to the outside provides a means of removing the cover when inspecting the shaft or the packing of the pump.

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NEWS

UOP Begins Lecture Series

Universal Oil Products Company has inaugurated a series of lectures to be delivered monthly at its Riverside Laboratories by outstanding scientists and technologists, to suggest and stimulate new lines of thought among Universal research workers.

The first lecture in the series was given by Carl S. Marvel, head of the organic division of the Department of Chemistry at the University of Illinois. His subject was "High Polymers." The second lecture, on "Polycyclics," was delivered by W. E. Bachmann of the University of Michigan. The schedule of coming lectures includes "Hydrides," H. I. Schlesinger, University of Chicago; "Petroleum Substitutes," H. H. Storch, Pittsburgh Experiment Station, U. S. Bureau of Mines; "Silicones," E. G. Rochow, Harvard University; "Halogenation," E. T. McBee, Purdue University; "Role and Application of Reaction Kinetics in Analytical Chemistry," I. M. Kolthoff, University of Minnesota;"Peroxides," M. S. Kharasch, University of Chicago; and, "The Function of the Consulting Chemist," C. S. Miner, Miner Laboratories and a director of Universal.

Shell Wins Safety Award

With an accident-free period of nearly 2,000,000 working hours, the Wilmington-Dominguez, Califiornia, refinery of Shell Oil Company, Inc., has been awarded the Accident-Prevention Award by American Petroleum Institute, president W. R. Boyd announces. The time period extended from November 25, 1947 to August 3, 1948, without a disabling accident.

In Sales Post

Harry P. Smith, formerly New York district sales manager of Mathieson Chemical Corporation, has been made assistant general manager of sales, it is announced by E. E. Routh, vice president and director of sales. His headquarters will remain in the company's New York offices.

A native New Yorker, Mr. Smith graduated from Columbia with a B.S. degree in 1921. Prior to joining the Mathieson sales department in 1944, he was president of the George Chemical Company, now a division of Diamond Alkali Company. He is a member of the Chemical Salesmen's Association of New York and Alkali Distributors of the New York Metropolitan area.

Builds Pressure Unit

A $700,000 pressure maintenance plant is under construction at the Sand Creek Field in north central Wyoming by General Petroleum Corporation, to handle about 2,000,000 cu ft of gas per day. The unit will recover condensable hydrocarbons from the gas which is produced at the rate of 1500 cu ft per bbl of crude recovered from the field. The installation is built around a 300 hp Clark two-cycle MA-8 angle compressor which will reinject 1,750,000 cu ft of stripped gas per day, to increase the crude yield.

Automatic control makes possible operation of the continuous plant with less than 24 man-hours per day. Metering and gauging wells, etc., is controlled from a single building, and operation in winter is facilitated since the men need not go more than 100 ft distance from the central building. Utah Construction Co. is contractor for the field work. The field is all located on Government-owned land, with eleven wells to be producing by January 1, 1949, the production to be limited to 1000 bbl per day. The crude is called "golden," of about 48 API gravity, from about 6700-6800 ft.

Low-grade Fuel Consumption In Europe Declines

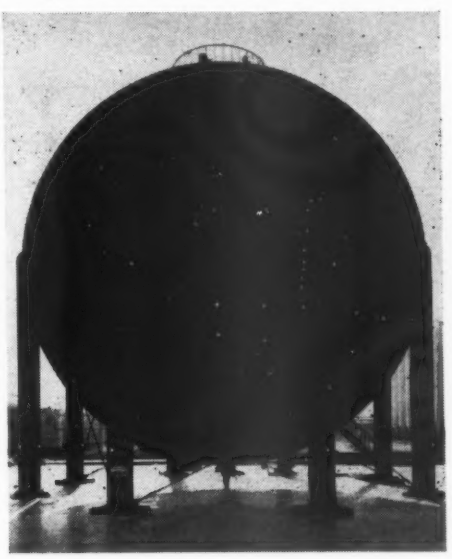
The coal situation in Europe is changing from one of shortages to that of surpluses, especially in the low-grade bracket, said Carl E. Miller of Battelle Memorial Institute to the mechanical and the mining engineers meeting at White Sulphur Springs, in November. "The greatest hope for the long pull in Europe," said Miller, "is in increasing the utilization of low-grade fuels which are presently becoming a surplus. This is more than an emergency measure, he stated, as increase in the mechanization of mines and coal handling will produce smaller sizes of coal with higher ash content. Availability of better grades of coal, and especially that imported from USA has prevented the consumption of much of this low-grade fuel now starting to pile up.

Over-taxation Throttles Industry's Research

Stifling industrial research and the commercialization of new processes and products by the back-breaking taxes of today threatens the national security and living standards, Dr. Walter J. Murphy indicated in discussing recently these developments before the assembled American Chemical Society members from Oklahoma. Drying up risk capital is the result of this "ruinous" taxation policy, Murphy said; without risk capital new products cannot be placed in production even if the process for their making has been developed to the commercial stage. This prohibition starts a chain reaction for the curtailment of research and production which affects every phase of American life. No incentive exists for a company to develop new products if no risk capital is available to commercialize these products. A signal proof of the result of this dangerous taxation is the lethargy and technological stagnation from which Great Britain has been suffering, Murphy showed.

Strain Gages Measure Stresses in Spherical Tank

Measurement of stresses in the shell of a spherical tank (Hortonsphere) by the application of strain gages has been carried out successfully by two engineers, L. P. Zick and C. E. Carlson of Chicago Bridge & Iron Company. Employing the SR-4 strain gage technique, developed by Baldwin Locomotive Works, they established essential agreement between theoretical calculated values for these stresses and those shown by the strain gages. The accompanying photo shows the points, outlined by white discs, at which these gages were applied for this study. The tank was built for Cities Service Oil Company at East



Chicago, to contain 10,000 bbl of volatile petroleum hydrocarbons at a working pressure of 60 psig. A report of the method and the results was made before the Society for Experimental Stress Analysis recently, published in the Proceedings, Vol. VI, No. 2. This type of structure and that of many others employed in industry, makes theoretical calculations highly complicated and time-consuming compared to time required to determine values by strain gage procedure.

modern plant design includes LUNKENHEIMER VALVES

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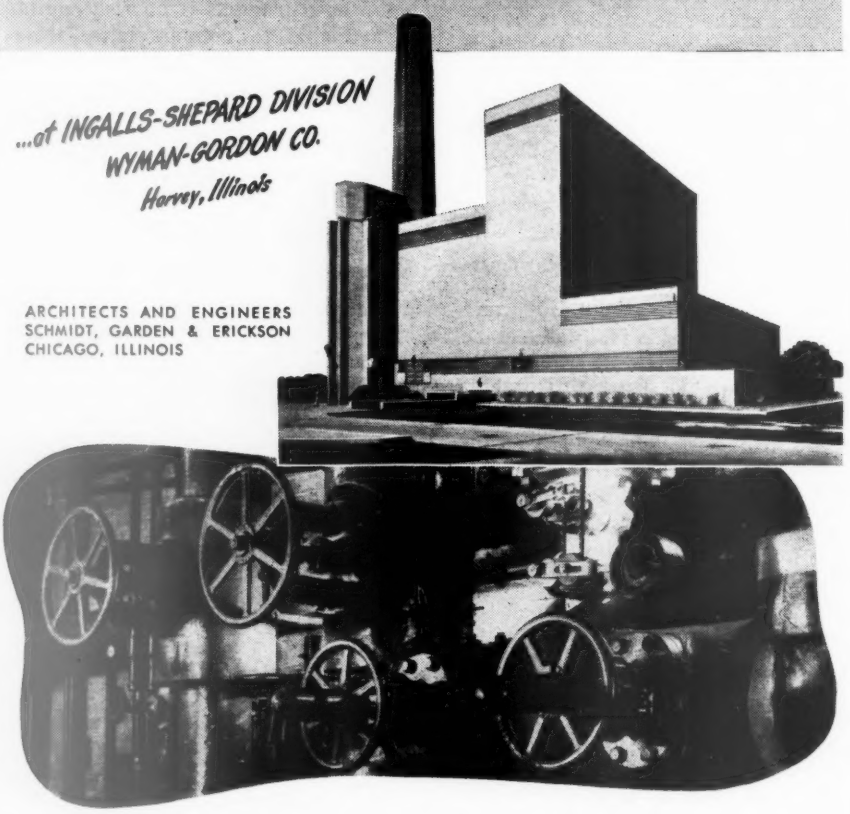

Housed in a strikingly modern, all-reinforced concrete, windowless building, the power plant of this manufacturer's forge shop is a picture of modern efficiency. The list of principal suppliers reads almost like "Who's Who" of power house equipment manufacturers.

Among these big names is that of LUNKENHEIMER . . . identifying high and low pressure valves that serve in multiple installations on lines and equipment.

The 85-year old LUNKENHEIMER reputation back of a widely varied line of quality valves has gained the confidence of planning and operating men alike. That's the reason LUNKENHEIMER VALVES are so often specified for modern installations . . . for long life, minimum maintenance and true, low-cost service.

Lunkenheimer Valves are available through Distributors in all industrial centers.

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More Power to Industry Through LUNKENHEIMER VALVES

Petco Building Houdriflow Unit

A 5000 bbl-per-day charge capacity Houdriflow catalytic cracking unit is to be built for Petco Corporation at its Blue Island, Illinois, refinery, according to announcement by Gen. David N. Hauseman, president of Houdry Process Corporation. Signing of contracts with Petco, Houdry Process, and Clark Construction and Engineering Company of Milwaukee, who are contractors on the job, was announced by A. M. Paine, president of Petco.

The new process is an improved design of the Thermofor Catalytic Cracking process, developed originally by Socony-Vacuum Oil Company. The new unit is designed to employ a gas lift for circulating catalyst, instead of the older conventional method of using mechanical elevators for this purpose. The unit will be constructed to use as much of the existing thermal cracking equipment as possible, which thermal unit will be discontinued as soon as the Houdriflow unit begins operations.

Aramco to Spend $520 Million

Arabian American Oil Company and subsidiary Trans-Arabian Pipe Line Company plan to spend $520,000,000 in expanding their overall operations during the five-year period 1948-53, respective presidents W. F. Moore and B. E. Hull announced recently. Of this sum $200 million will be spent for TAPLine and the remaining $320 million for the producing and supporting facilities of Aramco. About 145 miles of the main TAPLine have been laid, Moore and Hull announced; about 100 miles more are being installed in Saudi Arabia at the rate of five miles per week; the initial capacity of the line will be 300,000 bbl per day, and will eliminate 7200 miles of round-trip tanker travel circumnavigating the Arabian Peninsula and through the Mediterranean. Final capacity of the line will be 500,000 bbl per day. Oil required for Europe under the Marshall Plan can be supplied by this line with a minimum of cost and delay when it is completed.

Socony Receives Award

Socony-Vacuum Oil Company, Inc. at Augusta, Kansas has been awarded the Certificate of Appreciation by the American Legion through its State commander, Joseph Nickell of Kansas. This company is one of 30 receiving this certificate for outstanding records in employing physically handicapped war veterans. Socony's Augusta plant employs 228 war veterans from both World Wars, or 42.5 per cent of its personnel.

NEWS

Continental Doubles Capacity At Denver Refinery

Increasing its crude capacity from 3500 bbl per day to 6750 bbl per day the Denver, Colorado refinery of Continental Oil Company went on stream recently with the most flexible arrangement of units in its history, Harold G. Osborn, refining vice-president for Continental announces. The new and revamped plant includes Thermofor catalytic cracking, catalytic polymerization, new vapor recovery and gasoline stabilization units, and increased liquefied petroleum gas capacity, all added to the existing refining facilities. Crude topping capacity was increased, and the thermal cracking-reforming capacity is utilized to crack catalytic recycle gas oils as well as naphthas. The plant can process any of several crudes obtainable in the Rocky Mountain region, cost $5,800,000. Local officials are Charles Morgan, superintendent; assistant superintendent J. W. Smith; resident engineer C. B. Popkin and resident chemist Foster L. Battle.

NGAA Meets

Plant operation and maintenance problems were the chief subjects for discussion at the Panhandle - Plains meeting of the Natural Gasoline Association of America meeting in the Herring Hotel, Amarillo, on December 10. Among the subjects covered by papers and discussion were, Dehydration of Natural Gas; Heat Exchanger Maintenance; Meters; Increasing Gas Pumping Capacity by use of cylinder clearance pockets; Safety Practices; Practical Fractionation, and Crude Oil Distillation, the last an animated film supplied by Shell Oil Company, Inc.

Addresses on industry trends were given also by C. R. Williams, president of the NGAA, by L. R. Hagy, of Hagy, Harrington and Marsh, and rillo's mayor, and E. O. Thompson, chairman of Texas Railroad Commission.

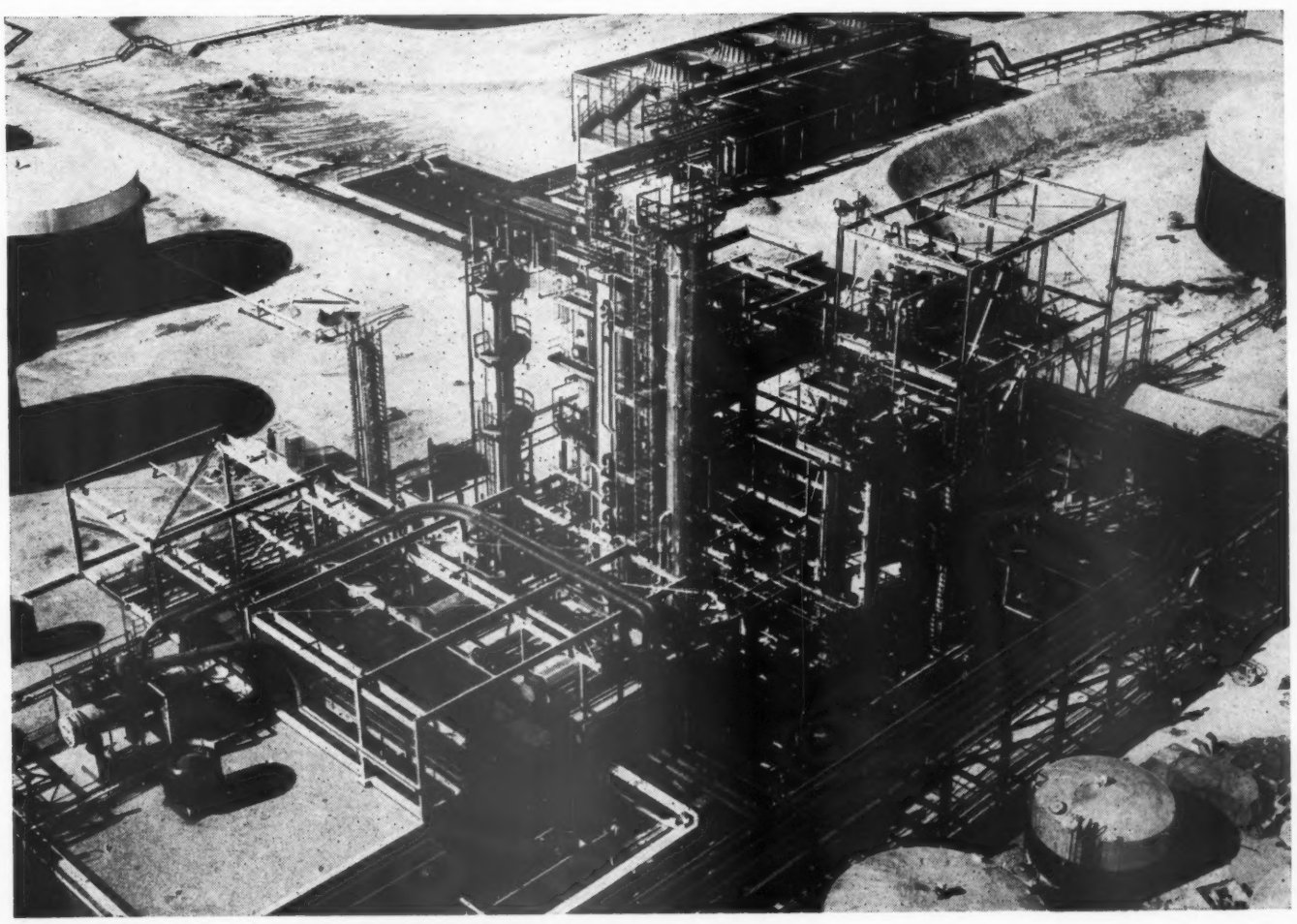
Mexican Officials Visit U. S. Refineries

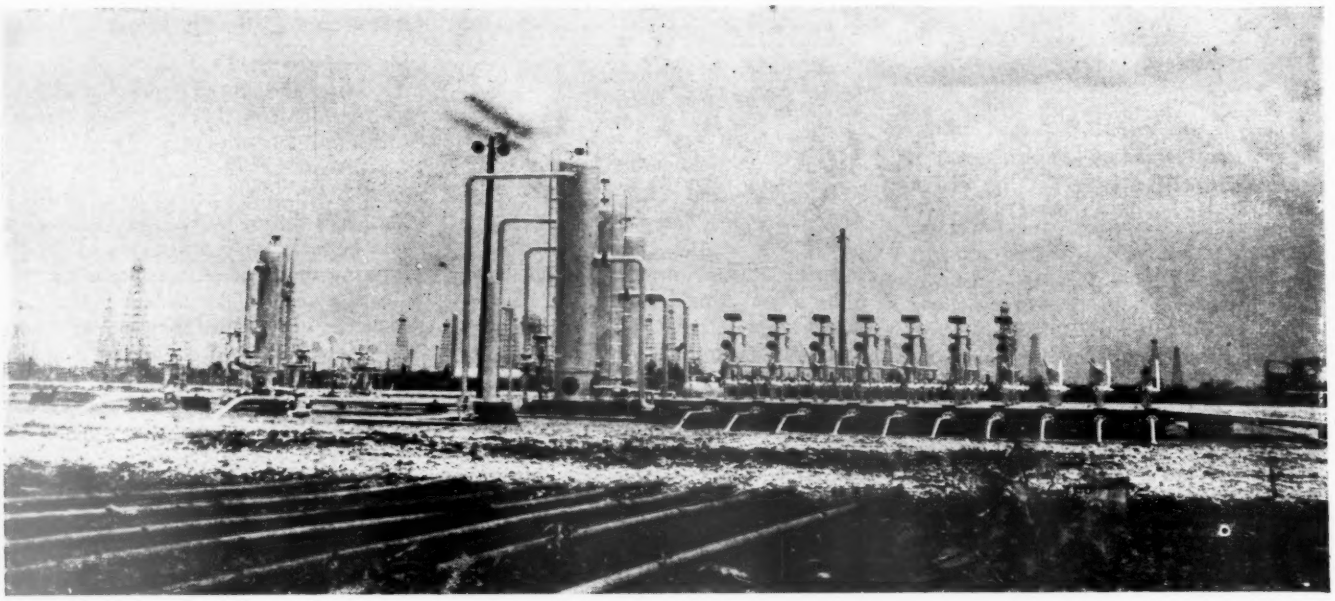
Carlos Corcuera, general manager of refining for Petroleos Mexicanos, oil administration for the Mexican Government, accompanied by Teodoro Reith, manager of the Northern Mexico refining zone, are visiting in this country to learn more of U. S. refining methods. After attending the meeting of the American Petroleum Institute in Chicago they moved on to Cleveland and were shown through the offices and laboratories of the Arthur G. McKee Company there; McKee is building a large refinery at Salamanca, Mexico, and enlarging the Poza Rica refinery, for the Mexican government.

Diamond Dedicates Plant

With a potential output of nearly 500 tons of liquid chlorine and caustic soda per day, the new plant of Diamond Alkali Company, at Pasadena, near Houston, Texas, was dedicated in November. The new plant makes both products by the electrolytic process, and cost $14,500,000 to build.

This view of Continental's Denver refinery shows portions of new construction. Left foreground is the gas plant, and immediately behind, center, is the liquid petroleum gas plant. The unit immediately behind and adjoining is the catalytic polymerization unit. In the far background is cooling tower.





Field Installation for the Conservation of NATURAL GAS

This Texas Gulf Coast installation designed by Maintenance handles ten wells. Oil and gas flow from the lease into the ten selective manifolds, thence to separators suitable to working or flowing pressure. The gas separated in these units goes into a gathering system, is compressed and reinjected into the formation, eliminating flares and gas waste.

In this installation, the 125-lb. W.P. separator is so arranged with gas meter runs and oil meters that, with selective valving on the selective manifold, any well on the lease can be tested. Each separator is equipped with a Smith positive displacement oil meter that registers the total production of wells flowing into this separator, thereby relieving the producer from actual tank gauging, except for periodic checks.

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MECO

Absorption Plant Building

New absorption plant is to be built by Brazos River Gas Company, to process the gas being supplied to the city of Mineral Wells, Texas. Liquid recovery capacity will be about 15,000 gal per day, including the recovery of 75 per cent of the propane in the raw gas. The Brazos company will handle the construction with its own staff. Robert L. Purvin and Richard Henry, consulting engineers of Dallas have been retained to supervise construction and to handle the operation and processing for the plant. Construction has already started on the plant.

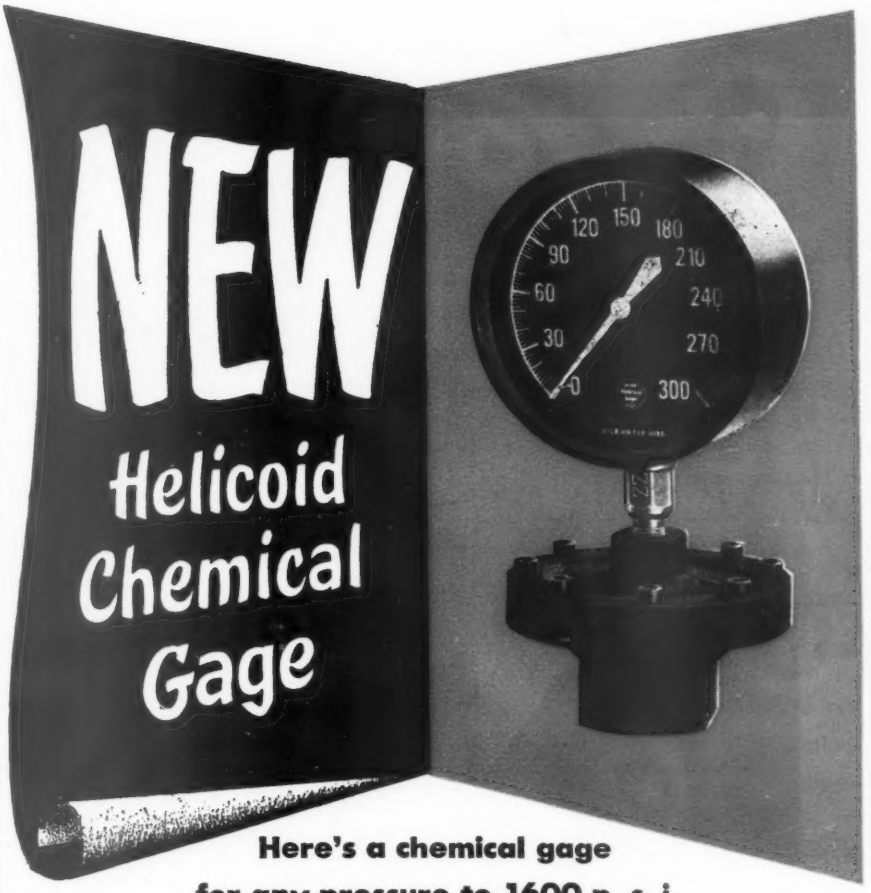
Gas Desulphurization

Stacey-Dresser Engineering Division of the Stacey Brothers Gas Construction Company, member of the Dresser Industries, Inc., announces that agreement has been reached with the Panhandle Eastern Pipe Line Company for exclusive rights to a process that automatically desulphurizes natural gas.

Desulfo plants continuously remove excess hydrogen sulphide, require no operating personnel, and use only a very small portion of the gas for plant operation, it is asserted. Hydrogen sulphide is removed from sour gas by an ethanolamine solution that flows through an absorber and a regenerator in a closed system. Sour gas enters the absorber, where the hydrogen sulphide is transferred to the amine solution. Regeneration of the amine is accomplished by steam stripping, using a small part of the sweet gas for the boiler. The hydrogen sulphide is then vented to the atmosphere. The only requirement for a Desulfo plant capable of handling 9,000,000 cu ft of gas per day is approximately a barrel of water a week and occasional amine makeup. No utilities are needed, it is stated.

Desulfo plants are built in four standard sizes and are capable of processing gas that contains up to 400 grains of hydrogen sulphide per 100 std cu ft. These plants are completely prefabricated and automatic in operation. Present delivery schedules call for 6 to 8 weeks delivery. Stacey-Dresser engineers report that with modification of the basic equipment, even larger quantities of hydrogen sulphide can be successfully removed.

Operators of small gas fields where the hydrogen sulphide content of the gas is above transmission requirements will profit from these plants, it is pointed out. Also, Desulfo plants can be used to sweeten gas used at the fields for gas engines, as sour gas increases engine maintenance costs.



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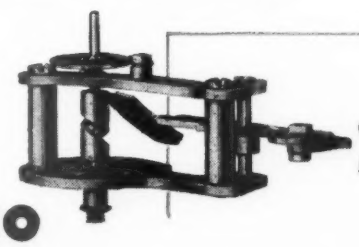
● **An accurate pressure gage for use where chemicals or viscous liquids either corrode or clog a Bourdon tube.**

The diaphragm is "TEFLON" which resists practically all corrosive chemicals. The diaphragm chamber is supplied of any metal most suitable for the service.

Write for complete information about the new Helicoid Chemical Gage.



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PERSONALS

W. R. Argyle

W. R. ARGYLE, until recently assistant manager of refining for Sinclair Refining Company, is the newly elected director and vice president in charge of Manufacturing, with headquarters in the New York office.

Argyle enters on this most important job after 30 years with the Sinclair Company, a period of service starting immediately after the close of World War I. In that war he served as assistant physicist with the U. S. Bureau of Mines, in the cooperative study, with the Emergency Fleet, for developing suitable water-tube boilers for marine service. Prior to that time for two years he was a teacher, after graduating with a degree in engineering from the University of Utah, in 1915.

Came Armistice Day, 1918, and Argyle went to work for Sinclair, in charge of all fuel and utilities, for all operations in its refineries. By 1924 the refinery at Marcus Hook, Pennsylvania, was short a superintendent and he was given the reins. For 19 years he spent his time making better and cheaper fuels, lubricants, etc., until he called for and received leave of absence to take over the job of assistant director of refining, later promoted to associate director, in the Petroleum Administration for War. Getting and transmitting enough aviation and motor fuels, lubricants and other products to the Armed Forces on and in time, he returned to Sinclair in 1945 and was made assistant refining manager forthwith. Under such conditions as have obtained in refining circles since the end of the War, sinecures do not exist; like many another executive in this industry, Argyle had the same job as had the Israelites in Egypt in Biblical history; making 'bricks without straw' is probably less complicated than making more gasoline and heating oil from less crude and without adequate process equipment. The history of that job in Sinclair refining division as well as in the remainder of the industry, is still in the successful making. His elevation to his present position came as of October 1, 1948, and entails no change of operations base. With 10 refineries, totalling a reported daily capacity of 277,500 bbl of crude, and distributed well over the United States, his responsibility to his company and his company's customers is tremendous.

Westchester County of New York is the home of a very great number of important men who have large shares in directing the business of this country, and Argyle lives in Scarsdale, one of the numerous attractive residential suburbs in that world-famous area, where municipal boundaries of adjacent cities have a common dividing line, and "the country" refers to the Kaatskill (now Catskill) or Adirondack mountain regions. He has had time to be gregarious, as witness his membership in the Union League Club of Philadelphia; more recently he has taken membership in the Manursing Shore Club located in nearby Rye, another Westchester County suburban city.

Married, he has three daughters.

▸ **Dr. J. B. Rather,** technical adviser to the manufacturing committee and formerly chief chemist and general manager of Socony-Vacuum Oil Company's research, development and technical service laboratories, has retired from active service with the company; he will remove to San Antonio, Texas, to live. Rather started with the company in 1918 as assistant chief chemist; he has been active in American Society for Testing Materials, American Petroleum Institute and other technical and trade organizations for 30 years.

▸ **W. H. Peterson** has been named manager of the Chicago office of the Enjay Company, Inc., subsidiary of Esso Standard Oil Company, the company announces. Peterson has been rubber and plastics salesman for the company in the midwest since 1943, and will continue in that capacity. He is prominent in the rubber division of the American Chemical Society and is secretary-treasurer and vice chairman (1948-49) for Chicago Rubber Group.

▸ **Dr. R. E. Greenshields,** director of Shell Oil Company's Wood River Research Laboratories, and the laboratory organization were hosts recently to a large group of college professors who toured the entire laboratory assembly and were made acquainted with the great number of research and development projects under way there. Ten men of the top technical staff piloted the group and explained in considerable detail the workings of the laboratories and problems that are being pushed toward solution. The effort was a part of the plan to acquaint educators with the work of the oil companies and the requirements for ability for mechanical engineers; by this process the professors become better informed on the needs of industry and can thus direct more intelligently the training of their students.

PERSONALS

Samuel M. Gahagen has been appointed chief metallurgist by the Jessop Steel Company, Washington, Pennsylvania.

Gahagen previously served in metallurgical and other technical capacities with American Steel and Wire Company, Crucible Steel Company, the Vanadium Corporation, and finally the Rustless Iron and Steel Corporation before his association with Jessop Steel. He received his education at Pennsylvania State College, the Carnegie Institute of Technology, and the University of Buffalo.

M. E. Spaght, vice president of Shell Development Company, will succeed **A. E. Lacomble** as president on January 1, 1949, when Lacomble becomes chairman of the board, it was announced today by Alexander Fraser, president of Shell Union Oil Corporation, of which Shell Development is

A. E. Lacomble *M. E. Spaght*

an affiliate. Spaght will move from New York to the Company's headquarters in San Francisco, and Lacomble will go to New York.

Spaght joined Shell Oil Company in 1933 as a research chemist in the company's Martinez refinery. He went to Europe as a member of the U. S. Naval Technical Mission, and to Japan as a director of the U. S. Strategic Bombing Survey in 1945. He was appointed vice president of Shell Development Company in May, 1946.

Lacomble, Shell Development's president since 1943, joined Shell in 1920. After 5 years in the Dutch East Indies he became assistant superintendent of Shell's Martinez refinery in 1926. He was made vice president in charge of manufacturing in 1936 for Shell Petroleum Corporation in St. Louis. Lacomble was chairman of the executive committee of Shell Development until he became president.

Frank J. Smith has been appointed advertising and sales promotion manager of the Philip Carey Manufacturing Company, Cincinnati, Ohio, as announced by **E. W. Smith,** vice president in charge of sales. He succeeds Harold D. Bates, recently promoted to general merchandise manager. Smith joined the Carey Company in January, 1948 after several years with Owens-Corning Fiberglas Corporation. A graduate of Ohio State University and a veteran of World War II, he served 3 years as a naval officer in the Asiatic-Pacific.

Raymond R. Faller has been appointed coordinator of employe training activities in the industrial relations department of Ethyl Corporation, with New York City as headquarters. He has been manager of personnel and employe relations, at Ethyl's Detroit research laboratories since 1945, when he returned from three years in the Navy. He joined Ethyl in 1931 as automotive engineer, made training director in 1939, went into naval service in 1942. He is a native of New York, B.S. graduate in mechanical engineering from New York University; taught there and at Yale University and later was fuels engineer with U. S. Bureau of Mines.

J. Harold Perrine, who is administrative assistant in the Research and Development Department of Sun Oil Company has been elected alumni representative in the board of trustees of Grove City College, Grove City, Pennsylvania. Perrine graduated from Grove City College in 1930 and joined Sun Oil Company two days later as a chemical engineer. He holds 14 patents on resins, lubricants, fuel additives, soluble oils, and petroleum acid derivatives.

F. W. Vaughan, manager of the aviation department of General Petroleum Corporation, Los Angeles, has been appointed a member of the API Aviation Technical Service Committee by B. L. (Barney) Majewski, chairman of the general committee of marketing division of API, for the remainder of 1948 to serve out the term of W. D. Ellison.

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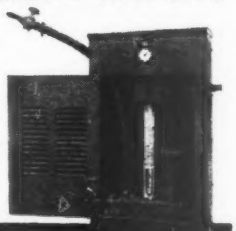
Paddock CHLORINATORS

Operates on high vacuum . . . no moving parts. 8 capacity ranges — 15 lbs. to 2000 lbs. of chlorine per 24 hours. Also ideal for chlorinating drinking water



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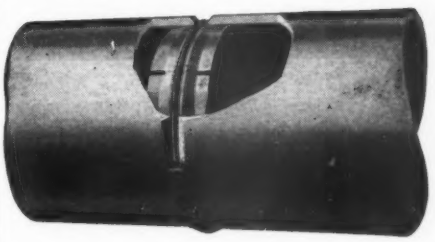

that WEDGE Chill Rings REINFORCE the joints making them the strongest part of the line. In case of shock, strain or vibration the pipe will fail before the reinforced joints. Because joints are reinforced you can SAFELY use thin wall pipe and save money. Why not investigate?

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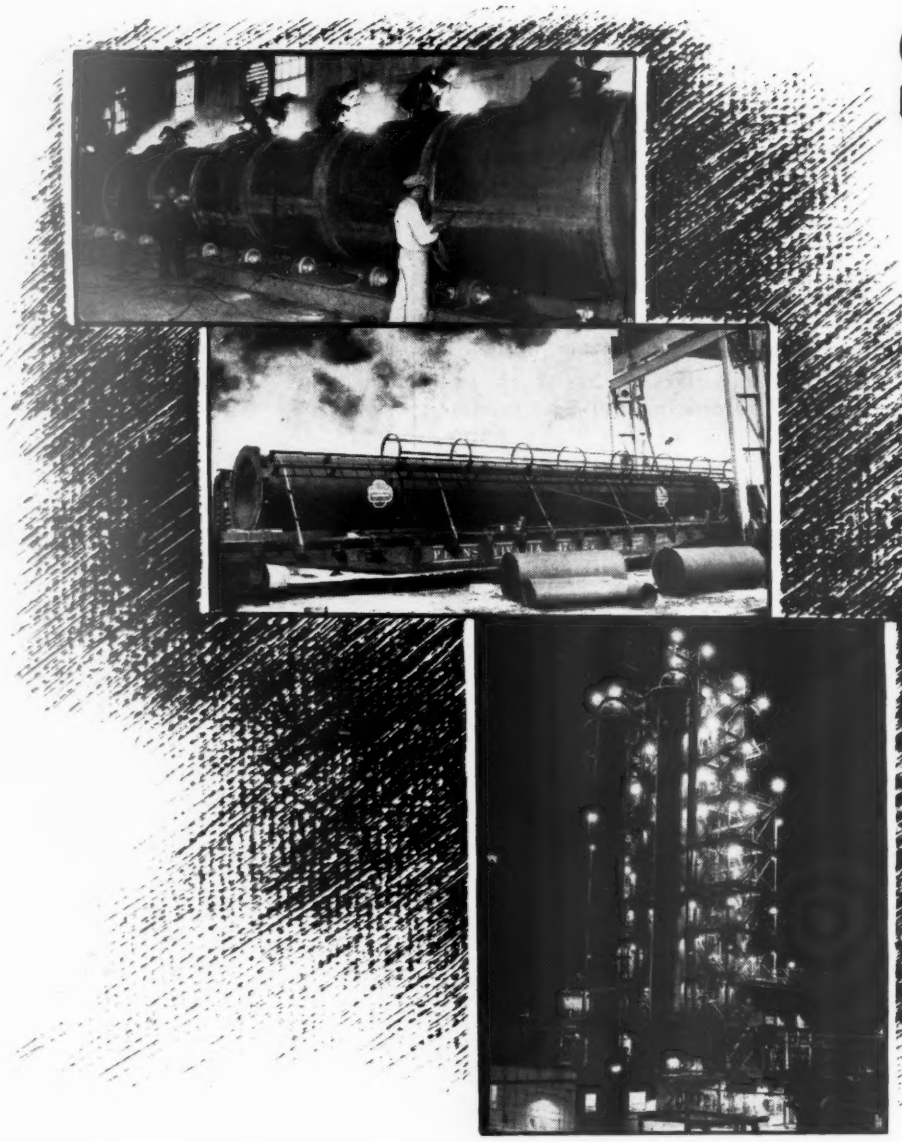

STEP BY STEP REFINERIES ARE BUILT

McNamar is rounding out another *year of record-building* steel fabrication service to the oil industry. In the course of 20 years at McNamar, countless fabricating problems have been shaped into powerful, dependable vessels — *vessels that faithfully serve the great OIL INDUSTRY — hour by hour.*

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NEWS

Sinclair Discontinues Plant

Discontinuance of the Coffeyville refinery of Sinclair Refining Company will be effective before the end of 1948, according to advice received from the company's headquarters in New York City by C. J. Gardner, Coffeyville plant manager. The plant's facilities will continue to be used as a pipe line and marketing terminal. The 500 and more employes will be given opportunity to transfer to other company locations, take retirement allowances or severance pay, it is stated.

Install Distillation Unit

A new vacuum distillation unit has been started in operation recently by General Petroleum Corporation at its Torrance, California, refinery to increase the plant's production of gas oil for catalytic cracking charge stock. Unit will handle heavy fuel oil residuum to make 12,000 bbl per day of heavy gas oil to charge to its four Thermofor catalytic cracking units for conversion into gasoline and distillate fuel oils. To obtain this additional charge stock will require the vacuum stripping of 32,000 bbl per day of heavy residual oil.

Brazil Plans Three Units

Brazilian refineries may be built in that country, says a recent proposal to the Brazilian Congress made by President Dutra, advices from Rio de Janeiro indicate. Three plants will be built according to the proposal, at Rio, at Sao Paulo and at Belem, will be under control of the country's National Petroleum Council and operated by three groups of Brazilian capitalists. Equipment will be bought in France and Czechoslovakia, to utilize frozen credits of $150 million.

New Skelly Gasoline Plant For New Mexico

Eunice Gasoline Plant No. 2 will be built at that location to augment the operations of Plant No. 1 at the same location, J. W. Vaiden, vice president of Skelly Oil company in charge of manufacturing, announces. It is a compression and absorption type plant and its raw products will be transported to the No. 1 plant for further processing, Vaiden said. The additional capacity is needed to process properly the supply of raw gas now available at that location.

J. A. Ramsey *J. P. Markey* *Norman Newton*

Continental Oil Company executives.

Montana Unit Officials

J. A. Ramsey is appointed superintendent of Continental Oil Company's new refinery under construction at Billings, Montana, transferred from Wichita Falls, Texas, in a similar position. Ramsey is succeeded at Wichta Falls by J. P. Markey, assstant superintendent there. Norman Newton is promoted from resident chemist to assistant superintendent, succeeding Markey. Malcolm Lider is promoted from assistant resident chemist to resident chemist and M. E. Oliver moves up from analytical chemist to assistant resident chemist at Wichita Falls, Harold G. Osborn, refining vice president of Continental announces from Ponca City.

"Maxim Silencers" For Catalytic Crackers

Sinclair Refining Company engineers in collaboration with the makers of Maxim silencers employed on firearms, have developed equipment to eliminate the excessive noise produced by large catalytic cracking units, announcement says. The installation includes a muffler system which has been placed on the company's Marcus Hook, Pennsylvania, and East Chicago, Illinois catalytic units, reducing the noise to unobjectionable proportions. These are the first catalytic cracking units to be so equipped, it is understood; the degree of noise reduction was proved by decibel tests.

New Esso Office Building

A new six-story office building for Esso Standard Oil Company at its Baton Rouge, Louisiana refinery is under construction, and it is expected to be completed early in 1950.

Heads Chemical Plant

E. S. Bodine was selected recently by the management of Shell Chemical Corporation to serve as manager of the Shell Chemical plant in the San Francisco Bay region, at Emeryville, W. P. Page, Shell Chemical vice president announces. Bodine succeeds Maarten Voogd who goes to New York as assistant to the manufacturing vice president.

Bodine graduated from Missouri School of Mines in 1923, went to Shell nearly a quarter of a century ago as draftsman at its Wilmington-Dominquez refinery. He joined Shell Chemical to superintend the Torrance plant in 1942; took charge of the U. S. Rubber Reserve butadiene plant there from 1944 to 1947, and is credited with directing improvements in this operation which increased production to a great extent.

General Promotes Brumbaugh

A. K. Brumbaugh, Jr., has been made engineer of design for General Petroleum Corporation with headquarters at Los Angeles, C. M. Reading, acting manager, engineering department, announces. Brumbaugh will have charge of all design of new installations and improvements in the company's plants. He joined the company in 1939 as an engineering inspector. He is active in technical and industrial organizations belonging to California Natural Gasoline Association, American Welding Society and the American Institute of Chemical Engineers. He has a B.S. in chemical engineering, summa cum laude, from University of Michigan and has written several articles on petroleum refining subjects.

SALIENT STATISTICS OF THE NATURAL GASOLINE INDUSTRY IN THE UNITED STATES, 1941-1947

(Thousands of Gallons)

	1941	1942	1943	1944	1945	1946	1947(S)
Production:							
Nat. gaso and nat.-gaso mixtures	2,208,360	2,071,104	2,115,372	2,188,284	2,498,741	2,691,001	2,743,837
Liquefied petroleum gases							
Isobutane	127,932	101,682	150,738	209,412	162,756	164,015	206,184
Other LPG	579,264	671,874	760,116	961,212	1,250,468	1,245,330	1,683,340
Other products	480,354	654,864	657,846	843,024	792,208	760,687	910,683
Total	3,395,910	3,499,524	3,684,072	4,201,932	4,704,173	4,861,033	5,544,044
Receipts from outside sources	87,676	62,991	55,600	112,182	120,074	118,850	122,705
Stock change at plants and terminals	— 39,774	+ 29,316	— 27,216	+ 789	+ 24,139	+ 33,996	— 26,481
Total Supply—Demand at plants and terminals	3,523,360	3,533,199	3,766,888	4,313,316	4,800,108	4,945,887	5,693,230
Shipments to Refineries:							
Nat. gaso and nat.-gaso mixtures	2,292,318	1,755,357	1,938,136	2,060,985	2,384,216	2,438,416	2,554,658
Liquefied petroleum gases	435,540 Ⓔ	428,501	463,955	534,274	657,018	381,175	407,479
Other products	*	501,725	466,143	629,949	496,895	412,905	476,398
To jobbers and trade outlets:							
Natural gasoline	402,318	274,794	162,890	118,608	94,155	157,523	177,848
Condensate					6,511	11,205	7,131
Finished gasoline and naphtha		141,006	129,262	134,610	229,948	265,819	356,776
Sales of LPG:							
For fuel	263,802 Ⓔ	302,190	486,738	608,881	668,698	862,229	1,238,189
For chemical manufacture	†	†	†	96,558	170,386	209,394	242,280
Transfers of cycle products	‡	‡	66,108	76,482	35,658	52,990	71,576
Exports from plants	50,791	43,778	23,612	28,351	31,453	120,171	160,895
Losses	78,591	85,848	30,044	24,618	25,170	34,060	
Stocks at plants, term'ls and ref:							
Natural gasoline	171,276	157,374	130,410	114,702	101,726	138,667	118,346
Liquefied petroleum gases	6,804	23,646	45,024	46,452	39,517	32,264	30,225
Other products	8,274	13,524	15,288	17,430□	40,270	38,278	31,847
Total	186,354	194,544	190,722	178,584□	181,513	209,209	180,418
Value at plants:							
Natural gasoline, $000	88,877	78,170	95,273	110,800 Ⓔ	112,018	111,140	‡
LPG, $000	13,305	19,000	24,410	34,300 Ⓔ	41,994	36,320	‡
Other products $000	16,938	24,395	27,227	37,400 Ⓔ	33,552	32,530	‡
Average per gallon, cents	3.5	3.5	4.0	4.3	4.0	3.7	‡
Natural gas treated, MM cu ft	2,763,300	2,864,400	3,028,000	3,300,000 Ⓔ	3,653,870	3,739,000	4,125,000 Ⓔ
Avg yield, light products except LPG, per M cu ft, gal	0.97	0.95	0.92	0.92	0.90	0.92	0.89 Ⓔ
Avg yield, all light products, gal	1.23	1.22	1.22	1.27	1.29	1.30	1.34 Ⓔ
Sales to consumers for fuel and chemical uses△:							
LPG	263,814	362,168	495,557	703,786	839,084	1,042,318	1,450,469 Ⓔ
LRG	199,038	223,272	179,676	356,370	437,682	662,964	744,140 Ⓔ
Total	462,852	585,440	675,233	1,060,156	1,276,766	1,705,282	2,194,609 Ⓔ
Total exports of nat. gaso and LPG○	53,886	57,414	35,154	42,702	62,971	177,959	‡

*Included in natural gasoline. †Included in shipments to refineries. ‡Not available.

□For comparison with 1945: 25,788 M gal of "other products" and 186,942 M gal for "Total" stocks.

△Independent survey of consumption: The figures above include sales to the synthetic rubber industry, whereas, for the sake of comparison, such sales have been omitted in the detailed study "Marketed Production of LPG".

○Figures from data compiled by M. B. Price, of the Bureau of Mines, from records of the United States Department of Commerce.

Ⓔ–Estimated: 1941 and 1944 by Bureau of Mines; 1946-47 by *The Petroleum Data Book*.

(S)–Subject to revision.

Source: United States Bureau of Mines

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

THE FIRING LINE

THE IMPORTANCE OF CATHODIC PROTECTION

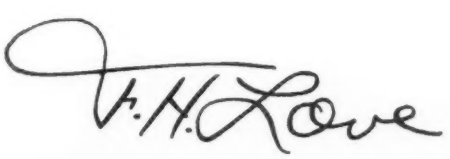
"A practical technique that will economically retard, control, or stop underground corrosion is a boon to industry. Corrosion is an electro-chemical action of Nature that attacks the metal in most industrial plant. Its ravage may weaken structures and cause accidents. It entails costly plant repairs or replacements. It may cause expensive commodities to leak and to damage property or endanger persons. It may interrupt production or service, thereby reducing income and discommoding customers. Such events usually bring public ill-will, customer ill-will, or other contingent losses.

"Underground corrosion attacks gas, oil, and water pipe lines, communications, power and signal cables, rail track systems, tanks and other metallic plant buried in or contacted by moist soil or water. The annual total loss to American industry due to repair and replacement of such structures plus the costs of lost commodities, lost income, and contingent losses caused by underground corrosion is estimated to be in the order of $1,000,000,000.

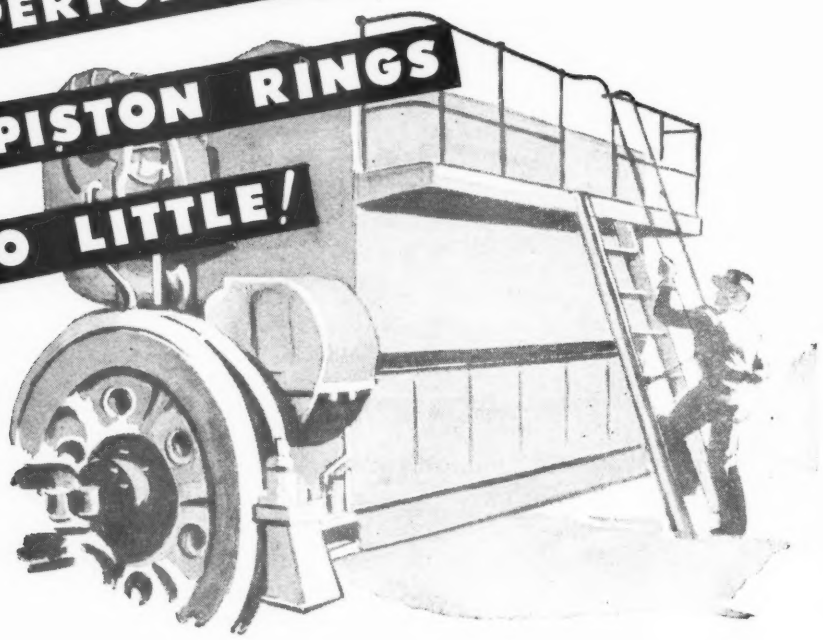
"The modern technique, cathodic protection, based on a simple principle known for a century, is an electro-chemical action that combats underground corrosion by beating Nature at her own game. . . .

"With almost 1,000,000 miles of buried pipe, 425,000 miles of railroads and railways, and 167,000 miles of buried cables in our nation, the possible value of cathodic protection is great indeed. That is why eight industry associations, two nationwide communications companies, and an engineering society have formed a joint committee (the Correlating Committee on Cathodic Protection) to inform management about it, to foster needed cooperation among operators in applying it, and to aid the solution of its technical problems."

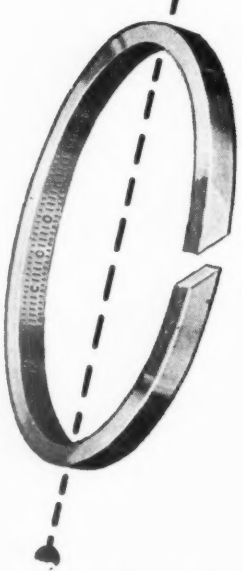
These are the words of H. H. Anderson, vice president and general manager of Shell Pipe Line Corporation, and chairman of the new Correlating Committee on Cathodic Protection, contained in a letter accompanying the first of four bulletins that will be released on the subject of cathodic protection. The bulletin is published in this issue of *The Petroleum Engineer*, page 262. It is well worth reading.



YOUR DIESEL PERFORMANCE DEPENDS ON PISTON RINGS THAT COST SO LITTLE!



. . . but how do you judge PISTON RINGS?



The only way to judge piston rings is by the results obtained in your particular engine. Unless the rings you use (1) keep the engine running at "new engine" efficiency, (2) hold cylinder wear to a minimum, and (3) give long, uninterrupted service, they must be judged expensive items, even though their original cost is so little.

So, whether you operate or build Diesels, be sure to use piston rings with proven ability to last longer, provide better engine performance, and reduce operating and maintenance costs. If you do, Cook Graphitic Iron Rings will be first choice, because:

1. They are engineered to have longer life and to reduce cylinder wear because of their exclusive ring material—Cook Graphitic Iron.
2. They offer exclusive designs for the elimination of blow-by in new and worn cylinders.
3. They are manufactured to provide the correct tension and light-tightness for the specific conditions under which they are to operate.

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Contract Let for Longest Gas Line

THE Trans-Continental Gas Pipe Line Corporation was granted on May 29, 1948, a certificate of convenience and necessity by the Federal Power Commission, for the construction and operation of a 2250-mile natural gas pipe line system for the purpose of transporting natural gas from the lower Rio Grande Valley to New York City. The project is estimated to cost approximately $200,000,000.

A manager constructor's contract for the entire project has been let to The Fish Engineering Corporation, Houston, Texas, for the complete design, engineering, and construction of all phases of the project. This is the largest single contract of its kind in the history of the natural gas industry. The Fish Engineering Corporation has been identified with the Trans-Continental Gas Pipe Line Corporation since its organization as consulting engineers, having done all the engineering work to date for Federal Power Commission, financial and other purposes.

The Trans-Continental system will have its origin in Hidalgo County, Texas, approximately 15 miles north of the Rio Grande River, near McAllen and will follow the coastal plain along the Gulf of Mexico and the Atlantic Ocean to its terminus on the east bank of the Hudson River at 132nd Street, New York City, a distance of 1839 miles. In addition to the 1839 miles of main line the system will require in excess of 400 miles of lateral lines for gathering supply gas and distributing sales gas.

Ray C. Fish, founder and president of The Fish Engineering Corporation.

Strip map of the main line route, showing the origin of Rogers Lacy field, in the lower Rio Grande Valley of Texas, and its terminus at New York City.

Work under this contract is already underway. Control points along the pipe line route have been established and aerial surveys are being made. Ground surveys on particularly difficult sections have also been inaugurated. The overall design and engineering of the project has been completed and detailed design work is now in its initial stages.

The main line will consist of 71 miles of 20-in. pipe, 558 miles of 26-in. pipe, and 1210 miles of 30-in. pipe. Accompanying is a strip map of the main line route, which shows the origin near McAllen, Texas, and the line passing generally by Alice, Victoria, just north and west of Houston, north of Beaumont, Texas, Lake Charles, Louisiana, and crossing the Mississippi River approximately 50 miles north of Baton Rouge, Louisiana. From this point the line travels in a general northeasterly direction near Montgomery, Alabama, Atlanta, and Athens, Georgia. Here the line turns in a general northerly direction passing near Spartanburg, South Carolina, Winston-Salem, North Carolina, Lynchburg, Virginia, west of Washington, D. C., north of Baltimore, Maryland, Philadelphia, Pennsylvania, and into Linden, New Jersey, thence north through Elizabeth and Newark, New Jersey, to its terminus on the east bank of the Hudson River, at 132nd Street, New York City.

The line is designed for an initial capacity of 340,000,000 cu ft per day and can ultimately be enlarged to a capacity of 500,000,000 cu ft per day. Compressor horsepower of 72,000, divided into ten compressor stations strategically situated along the line,

will be installed for the initial capacity of the line. An estimated 220,000 compressor horsepower divided into 19 stations will be required for ultimate capacity.

The Kaiser Company has contracted to supply 500,000 tons of steel plate over a period of approximately 24 months from its Fontana, California mill, at a minimum rate of 15,000 tons per month and a maximum rate of 25,000 tons per month. Consolidated Western Steel Corporation has contracted for the fabrication of the 30-in. and 26-in. main line pipe at Consolidated's Maywood plant near Los Angeles, California. The 20-in. main line pipe, 6-in. to 16-in. lateral line pipe, river crossing pipe, and miscellaneous small pipe, will be fabricated by the A. O. Smith Corporation in Milwaukee, Wisconsin.

The area traversed by Trans-Continental line between the Rio Grande Valley and the Mississippi River, and even beyond this point into the states of Louisiana and Mississippi, shows that it bisects the largest producing natural gas area in the United States. The estimated natural gas reserves in this area are approximately 90 trillion cu ft. Contracts for the supply of the entire requirements of the line have been signed with producers in this area, along with the dedication of adequate reserves for a 20-year period. Trans-Continental will take gas from the following fields: Conoco-Driscoll, La Gloria, West Gueydan, Starr County, Odom, Lube and Petronilla, Lacy, Quinto Creek, Bee and Live Oak counties, North Markum and North Bay City, Egan, West Bernard, Fresh Water Bayou and surrounding areas in Texas and Louisiana. The total gas reserves under contract approximates 4 trillion cu ft. Adequate gas reserves are available for the ultimate capacity of the line.

Considerable of the gas supply to the pipe line system will be "flare" gas, which will be put to useful use. Much of this gas is now being dissipated, thus making the new project another rung in the ladder of conservation.

R. D. Ricketts, vice president of The Fish Engineering Corporation.

Contracts for the sale of gas have been entered into with the Consolidated Edison Company of New York, Brooklyn Union Gas Company, Public Service Company of New Jersey, Philadelphia Electric Company, Long Island Lighting and Power Company, Brooklyn Borrow Gas Company, New York and Richmond Gas Company, and Elizabeth Town Gas Company. All sales quantities have been apportioned on the recommendation of the Federal Power Commission.

Arrangements for financing of the entire project have been completed. Common stock has been placed by private subscription and no public offerings will be made. Long term first mortgage bonds, which have been completely subscribed will provide for 75 per cent of the required funds. Approximately 50 per cent of the common stock of Trans-Continental is owned and controlled by Texas interests. The company was founded and initially financed solely by Texas people and Texas capital.

The Trans-Continental Gas Pipe Line Corporation was originally organized for the purpose of purchasing the Government-owned Inch Lines by independent oil and gas operators of Texas and Louisiana. At the time of biding on the Inch Lines an application was filed before the Federal Power Commission for a certificate of convenience and necessity to construct and operate a natural gas pipe line system over the route as now planned. Being unsuccessful in purchasing the Inch Lines, the company immediately went forward with its application to the FPC for the present pipe line system. Hearings before the Federal Power Commission were begun in October of 1947 and ended in May of 1948, with the granting of a certificate of convenience and necessity for the installation and operation of the system as planned.

It is anticipated that the complete engineering design and construction of all facilities will be completed by January 1, 1951. The first delivery of gas at the eastern terminus will be approximately November, 1950.

The longest pipe line system in the industry will have its headquarters in and be controlled from Houston during its construction period and initial stages of operation.

The Fish Engineering Corporation was formed in April of 1946, and is composed of Ray C. Fish, president; C. B. Ames and R. D. Ricketts, vice presidents; A. J. L. Hutchinson, O. L. Mullen, and J. R. Imber. Since its organization the company has engaged in the design and construction of compressor stations, pressure maintenance plants, gasoline plants, cycloversion plants, etc. This work has included the complete processing as well as the mechanical design and field construction work. ★ ★ ★

Private Shipyards Face a Lack of New Construction

The shipbuilding industry of the United States, which thus far this year has delivered 22 vessels and has orders for 81 others, though in a comparatively healthy status today, faces the loss of thousands of its highly skilled personnel and technicians within the next two years unless orders for commercial vessels are received by private shipyards in the near future, according to H. Gerrish Smith, president of the Shipbuilders Council of America and a past president of the Society of Naval Architects and Marine Engineers.

Smith said that by November 1, 1950, the private shipbuilding yards would have under construction only seven tankers and one passenger vessel and that the latter and four of the tankers would be completed before the end of that year.

"This," Smith explained, "according to present orders, will leave the industry facing 1951 with only one ship, a tanker, scheduled for completion in February. There are two other tankers at present unscheduled on order which may be completed in 1951 if not before. We must have orders for new vessels, otherwise shipbuilders will have no alternative other than dropping thousands from their payrolls."

There are 41 ships scheduled for delivery in 1949 consisting of two dredges, three trawlers, two ferryboats, and 34 tankers. Three tankers are scheduled for delivery in 1948.

FIG. 1. Lining up a joint of pipe for stringer weld on the Cities Service new Ulysses to Hutchinson, Kansas, line.

New Outlet for Largest Gas Field

By FRANK H. LOVE*

CITIES SERVICE GAS COMPANY has completed and placed in operation its new 26-in. pipe line between Ulysses and Hutchinson, Kansas. This is part of an overall project that. in 1949, will provide a system to transport Hugoton field gas all the way to Kansas City, a distance of 405 miles. To accomplish this the line will be extended from its present terminus to Ottawa, Kansas. Already pipe has been laid between Ottawa and Kansas City, completed during the summer. Other immediate phases of the project include construction of a 13-mile, 16-in. loop around the north and east sides of Wichita, which will be connected to the 26-in., and extension of the latter from Hutchinson to a point northwest of Newton where it will tie into the Sperling 6-in. line. The Newton segment was to have been a part of next year's program but pipe was made available sooner than expected and it was decided to advance the time schedule and proceed with construction of this additional 25 miles at this time.

The recently completed line has a capacity of 90,000,000 cu ft a day, pumping with one compressor station having 11 units. When the entire system into Kansas City becomes complete, the capacity will be increased to 270,000,000 cu ft a day by the addition of eight compressor units to the station. Further, an intermediate station at Greensburg is projected, which will again increase the capacity to 375,000,000 cu ft a day.

As is true with virtually all pipe line projects, the principal problem in connection with this job was the procuring of line pipe, and only the fact that sufficient pipe was not available prevented the laying of the line straight through at this time. To obtain what pipe it did, Cities Service found it necessary to pull a few rabbits out of the hat. Sheet steel was purchased at Houston, Texas, and shipped to Milwaukee, Wisconsin, to be rolled. This pipe has a wall thickness of $\frac{5}{16}$ in. and, inasmuch as it must withstand a maximum line pressure of 950 psi, the percentage of manganese in the

*Editor, Pipe Line and Marine Transportation.

EXCLUSIVE

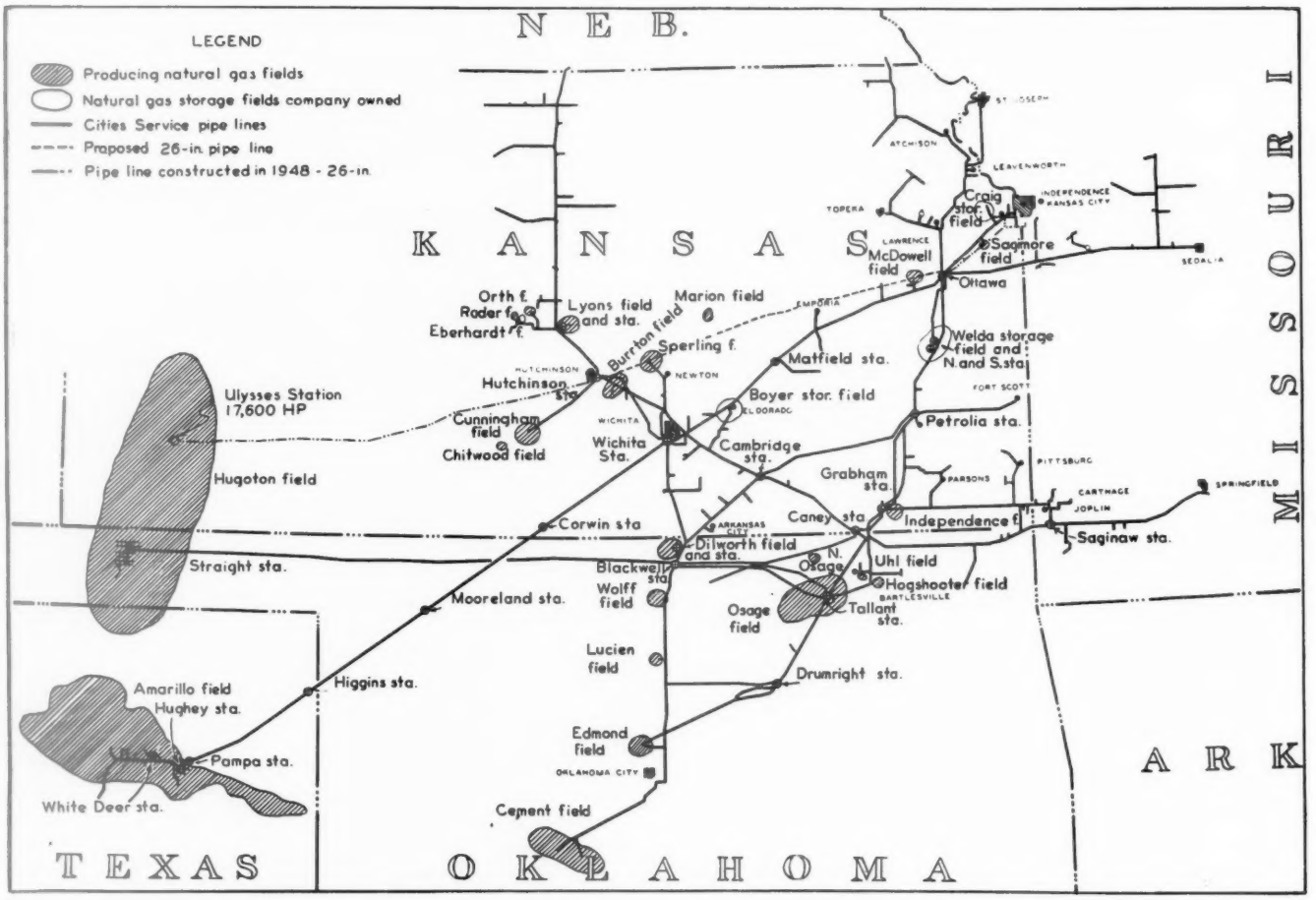


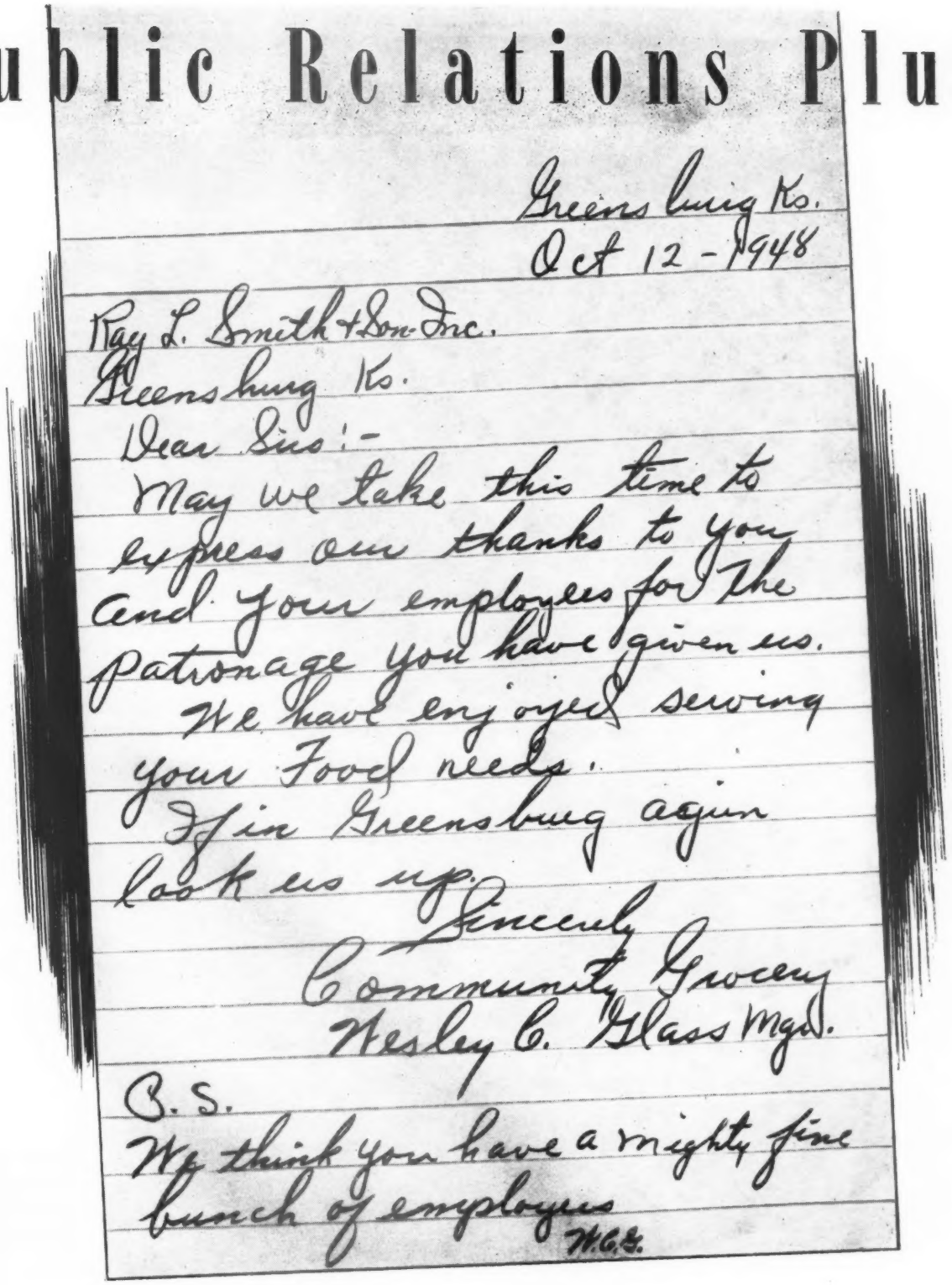
FIG. 2. Map showing Cities Service's new 26-in. system, which when completed in 1950, will provide a direct line from the Hugoton field to Kansas City. The sections of line from Ulysses to Hutchinson, and from Ottawa to Kansas City were finished this year.

steel was increased over that normally used. Pipe for the Wichita loop was reclaimed from the southern trunk line system of the company, which recently was replaced from Grabham station eastward.

▸ **Construction Features.** The first 50 to 55 miles of the right-of-way from Ulysses was through the plains country and consequently level. South of Dodge City the construction crews ran into hilly country, but it was of a nature to offer no special difficulties. This continued for 30 to 40 miles before sand hills were encountered north of Mullinsville and for approximately 40 miles trouble was experienced with caving ditch. The ditching machines were equipped with slopers as a means of combatting this condition and most of the caving was stopped. So satisfac-

FIG. 3. Sometimes it almost takes a gymnast to make a weld on a pipe line job. This operator is running a finishing weld.

Public Relations Plus!



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We have enjoyed serving your Food needs.

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P.S.
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RAY L. SMITH & SON, INC.

PIPE LINE CONTRACTORS

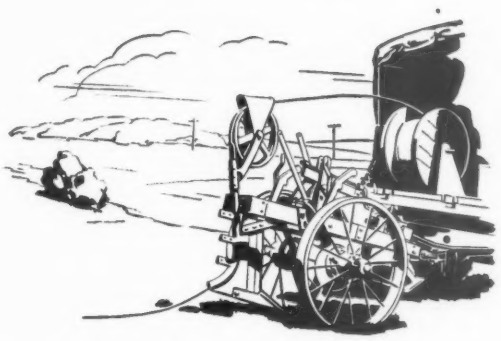
Hazlett Building — Eldorado, Kansas

FIG. 4. Backfilling after pipe has been coated and wrapped and lowered into ditch.

FIG. 5. These operators are finding flaws in the coating, or were until they stopped to mug. But, then, who doesn't when his picture is being taken?

FIG. 6. Dewatering near east side of Arkansas River diversion channel, using double row of sand points to reduce the water level. The 20-in. pipe already has been laid across the diversion channel from the west.

A GREAT *NEW* DOW DEVELOPMENT!



Here's important corrosion protection news for you. It's GALVO-LINE, a revolutionary new type of magnesium anode developed by Dow.

GALVO-LINE is a flexible, continuous, magnesium ribbon anode, cored over its entire length to prevent segregation and provide lasting electrical contact. It's the most powerful of the magnesium galvanic anodes—develops three to seven times more current flow per pound of anode metal installed. With GALVO-LINE, current requirements are at a minimum because the current source is a *line* rather than a point—current is distributed more uniformly and utilized more efficiently at the protected structure.

But that's not all. Look at the picture above and you'll see how GALVO-LINE is installed simply, quickly, and at considerably less cost than conventional anodes. For pipe lines for example, it can be installed mechanically by means of a truck or tractor-driven wire-laying plow fed from a reel of GALVO-LINE mounted on the plow or truck.

GALVO-LINE is versatile, too! It makes the magnesium anode practical for use in relatively high resistance soils. In low resistance environments it exerts a powerful polarizing action which tames corrosion quickly . . . paves the way for a smaller, cheaper, long-term installation. And it's flexible . . . GALVO-LINE can be bent and formed to conform to the geometrical requirements of a variety of different applications.

Get the facts . . . write to Dow.

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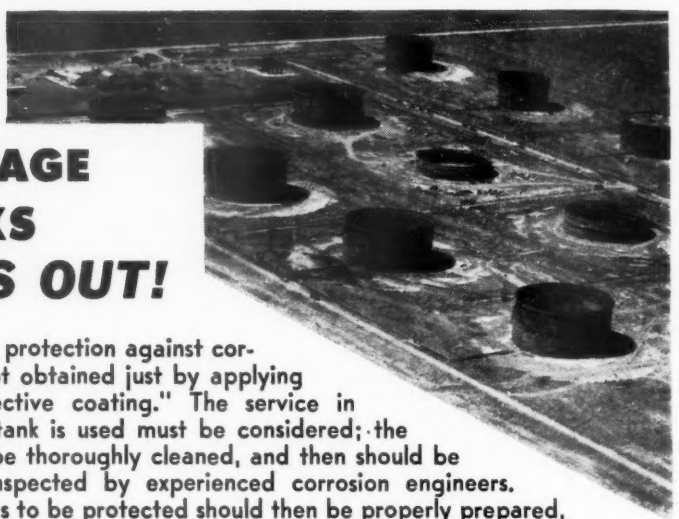

Adequate protection against corrosion is not obtained just by applying any "protective coating." The service in which the tank is used must be considered; the tank must be thoroughly cleaned, and then should be carefully inspected by experienced corrosion engineers. The surfaces to be protected should then be properly prepared, primed, and, finally, sealed with a coating designed to give maximum protection to each tank section from the particular type of corrosion encountered therein.

NATASCO assures maximum protection of equipment and investment because:

1. **Natasco engineers make a careful preliminary survey of every job.**
2. **Trained and experienced Natasco crews thoroughly prepare the tank surfaces before applying the priming coat.**
3. **Natasco engineers select the Natasco coating designed for maximum protection in each vulnerable area: Bottom, lower outside ring, B.S. section, vapor space and underside of deck.**
4. **Every Natasco job is *guaranteed to give satisfactory service.***

The NATASCO Company has a complete line of field tested protective coatings, a competent staff of experienced tank corrosion engineers, trained application crews and equipment designed for just one purpose, ***better tank preparation and coating application.***

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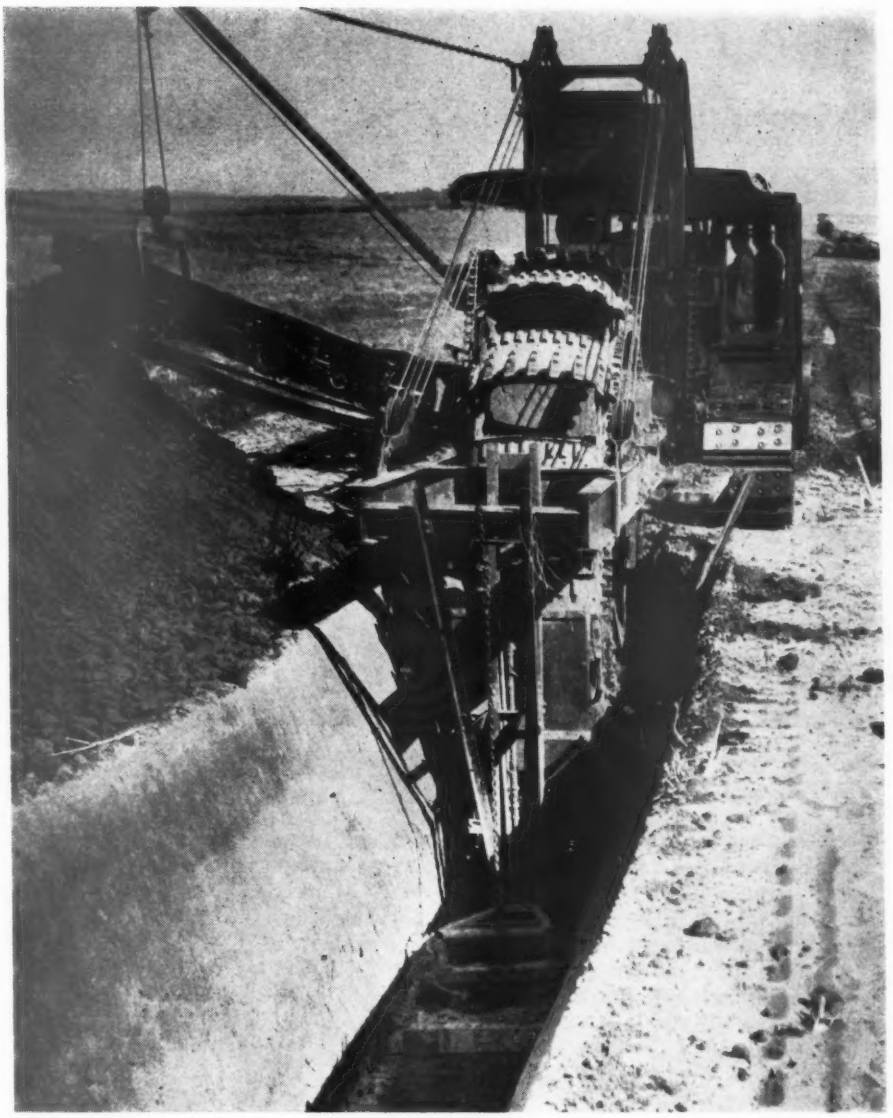
"Keeps new tanks new...Makes old ones do"

FIG. 7. Ditching machine equipped with slopers to keep the ditch from caving. A drag attached to the crumming shoe gave the ditch a flat bottom. Depth of the trench was 5 ft, 10 in. minimum, with the bottom 42 in. wide and sloping to a minimum width at the top of 84 in.



tory were the slopers, in fact, that their use was continued to the job's completion.

The ditch was dug to a minimum depth of 5 ft 10 in., with the bottom 42 in. wide and sloping to a minimum width at the top of 84 in. A drag attached to the crumming shoe gave the ditch a flat bottom. The pipe was given a minimum cover of 42 in. The ditching machines averaged a total of 8000 to 9000 ft a day; however, in this instance the amount of ditch made each day did not indicate what might have been done under pressure, as the "going" was easy and it was only desired to hold a three to four mile lead on the pipe gang.

The welders averaged about 7400 ft a day. The pipe was double jointed and the 80-ft lengths stove-piped into the line. An internal lineup clamp was used and the stringer bead run with Fleetweld No. 85 rod. The weld was then buffed and all slag particles possible removed. The hot pass was made

FIG. 8. Coating and wrapping the pipe in a single, continuous operation. The hot enamel was applied to a thickness of 5/32 in. The wrapper is asbestos felt.

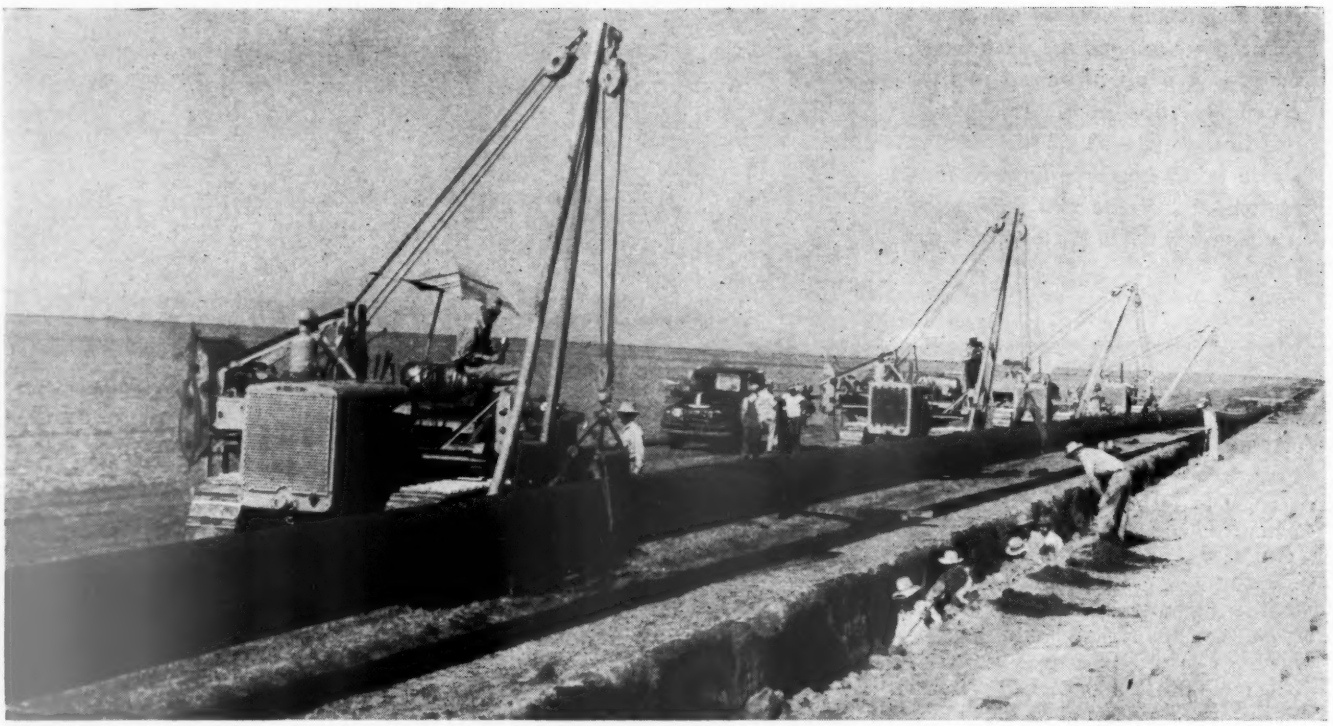


FIG. 9. Lowering-in the 26-in. pipe on the Ulysses-Hutchinson section of the gas line.

with No. 5 rod immediately afterward. The filler bead was then run, followed by the stripper and the cap. All except the stringer bead were made with No. 5 rod. It was necessary to use No. 85 rod on the stringer bead followed by No. 5 to obtain a high tensile strength weld because of the low ductility of the pipe resulting from the added percentage of manganese. The welding crew consisted of two stringer and two hot pass welders on the double jointing work, two stringer and 12 hot pass welders in the lineup crew, 14 finish welders, and three utility welders.

After being cleaned and primed the pipe was coated with hot enamel to a thickness of $\frac{5}{32}$ in. and wrapped with asbestos felt. Slack loops were left up approximately every sixth of a mile, varying with the terrain. Gate valves were spaced 10 to 13 miles apart. When a section between gates was completed a scraper was run to clean the pipe before the next gate was installed. The line was tested three sections at a time with 350 to 380-psi gas pressure. In approximately 24 hr the pressure equalized in the line and thereafter for a period of about three days a test was made every 24 hr.

FIG. 10. This machine was used to make wrinkle bends cold, to fit the pipe to the contour of the ditch.

Highway, road, and railroad crossings were cased with 30-in. casing. Welded joints were reinforced with sleeves and insulators installed between the casing and line pipe at intervals of 20 ft.

Arkansas River Crossing. Prior to this latest construction, i.e., the Ulysses-Hutchinson line, a crossing of the Arkansas River at the latter point was made. This work was begun in March and completed in May. Normally the river runs sluggishly over wide, sandy flats, quite innocent appearing. A cloudburst, however, can turn it into a raging torrent within a period of minutes. To anyone who has had experience with the Arkansas it is readily understandable why it is considered one of the world's most treacherous rivers.

The actual channel at the point of crossing was only 600 ft; however, it was necessary to extend the crossing 3000 ft on the west and 6000 ft on the east of the main channel. Instead of a

single 26-in. line, two 20-in. lines were laid as a matter of insurance against a possible break. The parallel lines were laid approximately 150 ft apart for the most part.

The trench for the pipe was made with draglines after the sand had been dewatered by means of sandpointing. At the outset, the course of the river was diverted so that sandpointing, trenching, and laying of the line could be accomplished across half of the channel, after which it was diverted to flow over the part already completed while the remaining work was done.

The river pipe was welded into sections and laid in the dewatered ditch by boom tractors, first, however, having been given an extra heavy coating of enamel and wrapped. Clamps weighing 1800 lb each were placed at 50-ft intervals at the approaches and at 15-ft intervals across the channel. To doubly protect against drifting, saddles were fitted over the pipe at 100-ft intervals and bolted to screw-type anchors that were twisted deep into the bottom of the river. The pipe was given a 4½-ft cover in the channel with the approaches sometimes having a covering of 9 to 12 ft.

After the pipe was laid, scrapers were run to clean it internally, and it was then tested for a pressure of 950 psi.

On the eastern end of the line (between Ottawa and Kansas City), which was completed during the summer, as mentioned, a considerably different type of terrain was encountered on the western end. Whereas on the latter no blasting whatsoever was required, between Ottawa and Kansas City rock was a considerable problem. Approximately 36,000 ft of rock had to be blasted and another 18,000 to 24,000 ft taken out with backhoes. Despite this fact, however, ditching progress was good and even through such areas averaged about 4000 ft a day. This section, also, was coated with hot enamel and wrapped throughout. Three welding beads were run and when tested after the entire section had been laid the line was found to be "tight." Although laying was completed June 6, the cleanup was not accomplished until a month later due to heavy rainfall.

▸ **Ulysses Compressor Station.** To pump the gas the 180 miles to Hutchinson a compressor station was constructed at Ulysses in Grant County, the originating point of the line. Eleven 26 x 38 1600-hp horizontal compressor units were installed, a total of 17,600 hp. Eight more such units are to be installed at a later date. Maximum discharge pressure is 950 psi. Auxiliaries include a generating plant to provide electricity and a gas dehydrating plant on the discharge of the station. In addition to the station building, 51 cottages have been built, an office building, recreation building, and auxiliary buildings—a sizeable town.

▸ **Contractors, Company Personnel.** Contractor for the line between Ulysses and Hutchinson and the loop at Wichita was Ray L. Smith and Son, Inc. Joe Work was general superintendent for the contractor and Bill Frost spread foreman.

Midwestern Constructors, Inc., laid the line from Ottawa to Kansas City. M. T. Wilhite was superintendent.

In charge for Cities Service Gas Company were George H. Baird, vice president; C. D. Rogers, superintendent of operations; L. C. Benne, assistant superintendent of operations, and M. O. Thomas, chief inspector.

The Arkansas River crossing at Hutchinson was made by Cities Service's own engineering and construction personnel. Thomas was in charge of construction. ★ ★ ★

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Covered with wooden slats to protect its coating, the pipe is lowered into a stream near Bangor, Maine.

MAINE'S FIRST PRODUCTS LINE

By L. R. DICKINSON*

SOMETIME this month (December) Maine's first pipe line for finished petroleum products will go into service. Constructed by Socony-Vacuum Oil Company, Inc., this 6-in. line extends from that company's marine terminal at Portland to Bangor, a distance of 127 miles.

Products for this line will be received into storage from tankers at South Portland and taken from storage into the pipe line. Other storage places along the line's route will be at Auburn, Hallowell, and Bangor. Highway tank trucks, as a rule, will relay the home-heating fuel, kerosine, and gasoline from these places.

This pipe line crosses the Androscoggin River south of Auburn and the Kennebec River at Hallowell. The Kennebec is navigable at the point of crossing and hence it was necessary to go below the barge channel into solid rock as the line was laid.

Associated Contractors and Engineers, Inc., of Houston, Texas, to which the contract was let for construction of this line, found that its most difficult problems in connection with the Maine pipe line was an unusual amount of hard rock to be excavated in trenching and the heavy timber to be cleared from the right-of-way.

In addition, large amounts of heavy timber to be cleared from the right-of-way also presented a few problems. Although the terrain traversed is mostly the rock-bound rolling hills found all along the Maine coast, the

*Pipeline Department, Socony-Vacuum Oil Company, Inc.

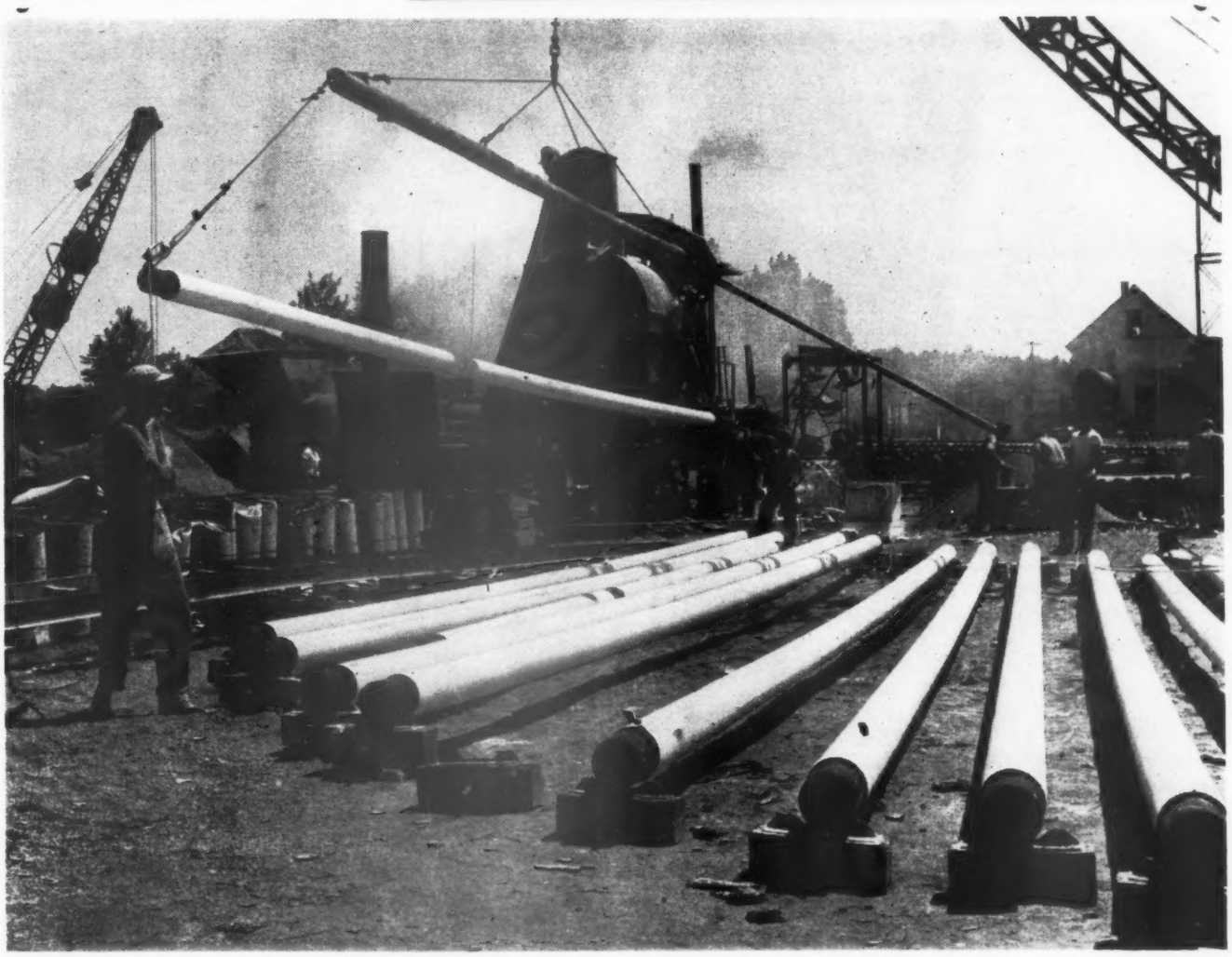
EXCLUSIVE

A ditching machine at work near Bangor, Maine. The line is the first finished products pipe line in the state and replaces barges, trucks, and other means of distribution for gasoline, kerosine, and fuel oil from the Socony-Vacuum marine terminal at South Portland.

preliminary survey for the route dodged practically all the numerous fresh-water lakes in the region.

The Portland-Bangor line is not regarded by Socony-Vacuum as a transportation economy measure and is being built on a lump-sum contract. In the words of George McDaniel, manager of Socony-Vacuum's eastern marketing area, "we regard the line as a means of making our Maine marketing operations more flexible." Transportation savings through use of the

After being mastic coated, pipe is stacked near Bangor until needed.



Here are shown the effects of dynamite blasting on rock along the right-of-way to make ditch.

Two especially-equipped tractors with sidebooms prepare to lower pipe into ditch crossing a stream.

line, even over the years, will be negligible.

The line became necessary because winter weather makes river travel impossible for two or three months out of each year. Heretofore distribution of finished products from Portland was principally by barges, which, after loading at the South Portland marine terminal, served major Maine points by way of the Penobscot River to Bangor, the Kennebec to Hallowell, and the Androscoggin to Lewiston.

In addition, the new pipe line eliminates any need for a great amount of "closed-season" storage of fuel oil, gasoline, and kerosine to carry over the winter-bound period. This means an end to a situation wherein supplies

of products during peak heating season were predetermined by storage capacities.

Socony-Vacuum felt also that, in the long run, it would be cheaper and easier to build a new pipe line than to enlarge the existing storage capacity at Bangor of approximately 100,000 bbl, which is about 138,000 bbl less than would be needed without the new pipe line. Other factors in this connection are that the Bangor terminal is too small for major expansion and that tank steel is in short supply.

Without the pipe line, Hallowell's present 100,000-bbl capacity terminal would have to be increased by another 35,000 bbl, and a new tanker would be needed also to replace the one with 20,000-bbl capacity that now moves products up the Penobscot River to Bangor and which would need replacement in another year or so.

When the pipe line is completed, a small terminal at Lewiston that serves the Auburn-Lewiston area will be closed and replaced by a 28,500-bbl terminal on the pipe line route at Auburn.

The terminal at Hallowell with its 100,000-bbl facilities, currently served both by tank car and water transportation from Portland via the Kennebec River, will be continued in operation except that it will receive its supplies from the pipe line after it is completed.

Socony-Vacuum's marine terminal in Portland, which is supplied by tankers from Beaumont, Texas, and other refineries, has a capacity of 660,000 bbl. The only additions here will be a pumping station and a products dehydration plant. Although the Portland storage facilities are being expanded by about 60,000 bbl, this expansion was planned without regard for whether a new pipe line was to be constructed.

Formation of rust that would destroy the inside of the pipe will be prevented by the dehydration plant at the Portland terminal, which will remove all moisture from products before they enter the line. Dehydration is a feature of almost all Socony-Vacuum lines by comparison with many other lines in which a rust-inhibiting or deterring agent is added to the products.

Any estimate of the capacity of this new line is impossible because there is no likelihood of keeping products flowing at near capacity rate. Its general level will be about 2 ft below the surface of the ground and it is being mastic-coated at three railhead points by the H. C. Price Company, to protect the exterior of the pipe against rust and other soil and weather effects.

* * *

Allowances to Annuitants

In an effort to assist its lower income group of annuitants in meeting the increased cost of living, Interstate Oil Pipe Line Company, an affiliate of the Standard Oil Company (New Jersey), will pay cash allowances to annuitants for one year to supplement the income they now receive from company benefit plans and social security.

The allowances will be made to annuitants having 15 or more years' service with Interstate or other affiliates of Standard Oil Company (New Jersey). The top limit to which supplemental allowances can raise any annuitant is $3000 total annual income ($250 per month) from company plans plus social security. Subject to this ceiling, eligible annuitants will receive varying amounts, depending upon their past participation in company benefit programs and social security.

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Oil pipe line construction since the war

By JOHN E. BOICE*

BEFORE speaking on the subject of postwar construction of petroleum pipe lines, I should like to impress upon you the magnitude of the oil pipe line system in this country. Reference is made to a statistical statement attached showing a comparison of selected financial and operating data for 71 pipe line companies reporting to the Interstate Commerce Commission at the close of the years 1941 and 1947.

You will note that at the end of 1947 there were 119,298 miles of interstate pipe lines, or 13,863 miles more than in 1941. Of the 73,389 miles of trunk lines in 1947, there were 61,561 miles of crude oil lines and 11,828 miles of refined oil lines. This by no means represents the total miles of petroleum pipe lines in this country. There are many miles of intrastate lines, particularly in California, that are not within the jurisdiction of the Interstate Commerce Commission. There are also several products pipe lines that, although crossing state lines, do not claim to be common carriers. Instances of this kind are the lines of the Standard Oil Company of Indiana, Shell Oil Company, Standard Oil Company of Ohio, and Champlin Refining Company. Although no accurate figures are available, Col. Johnson of the Office of Defense Transportation on July 12, 1948, estimated there were a total of 160,000 miles of oil pipe lines in the United States.

The investment in carrier property by the 71 companies reporting to the ICC increased a net $339,851,692 or 38 per cent between 1941 and 1947, thus illustrating the great expansion in facilities that has taken place since the war. It is interesting to note that of the total investment 66 per cent alone represents the cost of the pipe, fittings, and labor laying the lines. The remainder is made up principally of station buildings, pumping equipment, and oil storage tanks.

After deducting accrued depreciation, the combined pipe line systems may be considered in a 47 per cent physical condition at the end of 1947.

The pipe line companies as a whole are not over capitalized and have a relatively small unmatured funded debt.

Operating revenues have increased only $73,539,112 between 1941 and 1947, whereas operating expenses have increased $104,233,558, thus reflecting the greater operating costs in recent years.

Pipe line taxes, although extremely high, show a decline probably due to eliminating the excess profits tax.

Oil movements by pipe lines were 51 per cent greater in 1947 than in 1941, reflecting the increased demands for petroleum and availability of additional lines. The barrel-mile movements through trunk lines have likewise increased about 53 per cent in 1947 over 1941. Each barrel of oil moved an average of 263 miles.

Now turning to the status of petroleum pipe line construction in the postwar period.

A survey completed as of September 1, 1948, shows the following results for the principal oil pipe lines completed, under construction, or planned since the termination of the war:

	Mileage		
	Crude oil lines	Products lines	Total
Completed	3,502	5,045	8,547
Under construction	556	576	1,132
Planned	5,687	892	6,579
Total	9,745	6,513	16,258

The completion of 8547 miles of pipe lines in the postwar period has greatly improved the transportation situation, especially in West Texas, and has released many tank cars for other service. The conversion of the Big and Little Inch pipe lines and the Stanpac line in California from petroleum to natural gas service has been more than offset by new construction.

The 1132 miles of crude and products pipe lines at present under construction should all be completed by the latter part of 1948 or early in 1949. Some of the 6579 miles of lines planned to be built subsequent to 1948 are merely in the drafting stage and may never be constructed. However, it is reasonable to assume that the 1000-mile 20-in. Shell crude oil line from West Texas to Los Angeles, California, the combined Ozark Pipeline System and Texas line, consisting of 489 miles of 22-in. pipe from Cushing, Oklahoma to Salem, Illinois, the 600-mile 8-in. line of the Arizona Pipe Line Company between West Texas and Phoenix, Arizona, the Phillips 289-mile 12-in. line from Goldsmith to Borger, Texas, the Atlantic 400-mile 10-in. line from West Texas to Corpus Christi, Texas, the 236 miles of 20-in. loops along the existing Portland Pipe Line, along with other projects, will be built and be placed in operation between 1949 and 1952. The most important products lines presently planned to be built within the next few years are the 700-mile 8-in. Sinclair line from Sinclair, Wyoming to Kansas City, Missouri, and the 152-mile 6-in. extension of the jointly-owned Phillips-Shamrock line from La Junta to Denver, Colorado.

With the decline in Illinois production, and increased refinery runs, refineries in the Midwest are more and more dependent upon crude supplies from the Southwest. The completion of all pipe lines north, especially the Basin and Ozark systems, should provide all capacity required to meet their needs for some time. It is estimated the completion of these projects from the Southwest to the Midwest areas will increase capacities of all pipe line systems serving the East Chicago and St. Louis refining areas from 659,500 bbl daily in 1947 to about 1,025,500 bbl in 1949. At the termination of the war, it was possible to move only 592,800 bbl per day into those areas. It is observed that outlets from West Texas and New Mexico will considerably exceed present crude production if all projected lines from that area are built.

It seems appropriate to review what has been accomplished through the construction of the principal petroleum pipe lines in the postwar period:

▸ **Crude Oil Pipe Lines.** The 650-mile 20-in. Magnolia pipe line from Corsicana, Texas, to Patoka (Salem), Illinois, with a capacity of 100,000 bbl per day, was completed in June,

*A statement by Mr. Boice, petroleum transportation specialist, Oil and Gas Division, Department of the Interior, before the Interdepartmental Petroleum Committee.

1948, and connects at Corsicana with its existing pipe line systems extending from West Texas, East Texas, and the Texas Gulf Coast areas. At Patoka connection is made with its existing East St. Louis-Lima system. Original plans called for shipping 45,000 bbl of crude daily from Patoka to Lima, Ohio; 25,000 bbl from Patoka to East St. Louis, Illinois, and 30,000 bbl for delivery temporarily to the Texas-Empire pipe line for movement to East Chicago, Indiana. Prior to completion of this line, Magnolia delivered crude to the Sinclair lines at Panova, Oklahoma, for movement to East St. Louis. This movement has now stopped.

The 513-mile 20, 22 and 24-in. Basin Pipe Line System from Jal, New Mexico to Cushing, Oklahoma, owned jointly by The Texas Pipe Line Company, Empire Pipe Line Company (Cities Service), Shell Pipe Line Corporation, and Sinclair Refining Company was completed and placed in operation between Jal and Wichita Falls, Texas, in June, 1948. Contract has been awarded to lay the 170-mile 24-in. section from Wichita Falls, Texas, to Cushing, Oklahoma, and work is progressing and should be completed in February, 1949. The capacity into Cushing will be 167,000 bbl per day. Connection will be made at Cushing with the new line to be built by the Ozark Pipe Line System north to East St. Louis. Temporarily, tank car loading racks have been erected at Wichita Falls for shipping crude to midwestern refineries.

The Stanolind Pipe Line Company completed work this year in constructing 632 miles of 20 and 22-in. loops between Drumright, Oklahoma and East Chicago, Indiana. This work, started in 1946, greatly increased the capacity of the system for movement of crude to East Chicago or Wood River refineries. At Drumright connection is made with its existing systems from West Texas and Texas Gulf Coast areas and at Freeman, Missouri with the system from Wyoming.

The Stanolind Pipe Line Company in May, 1948, completed laying 82 miles of 16-in. loops along its Slaughter, Texas, to Drumright, Oklahoma line, which raised the capacity of the line to 103,000 bbl per day. Contracts have been let to further loop this line to raise capacity to 156,000 bbl daily by May, 1949.

Still another project that the Stanolind Pipe Line Company expects to complete by the end of 1948 is the construction of 430 miles of 8, 10, 12, and 16-in. loops along its Wyoming system terminating at Freeman, Missouri where it connects with its lines to East Chicago and Wood River.

The Ozark Pipe Line System, jointly owned by the Shell Pipe Line Corporation and The Texas Pipe Line Company, will build a 435-mile 22-in. line from Cushing, Oklahoma to Wood River, Illinois, with a capacity of 187,000 bbl daily. Work is scheduled to start shortly and be completed in May, 1949. This is a companion line to the Basin Pipe Line System that is being built from New Mexico to Cushing under different ownership.

The Texas Pipe Line Company will build a 54-mile 22-in. continuation of the Ozark system from Wood River to Patoka (Salem), Illinois, with a capacity of 187,000 bbl per day. Work is scheduled to begin shortly and be completed in March, 1949. At Patoka connection will be made with the existing Texas-Empire Pipe Line extending to East Chicago, Indiana.

The Rocky Mountain Pipe Line Company (Continental Oil Company subsidiary) completed a 118-mile 10-in. line, replacing present 6-in., from Denver, Colorado to near Cheyenne, Wyoming, and also laid 30 miles of 8-in. loop along the existing system in Platte County, Wyoming. This work raised capacity 26,000 bbl per day.

The Buckeye Pipe Line Company is enlarging its system by constructing a 110-mile 12-in. line from Cygnet to Cleveland, Ohio, to serve the refinery of the Standard Oil Company of Ohio.

The Salt Lake Pipe Line Company (Standard Oil Company of California subsidiary) is now engaged in constructing a 181-mile 8 and 10-in. line from Rangely oil field in Colorado to Salt Lake City, Utah. This line will be completed in 1948 and will have a capacity of 25,000 bbl per day for delivery to a new Standard refinery being built at North Salt Lake City.

▸ **Products Pipe Lines.** There have been many important expansions to products pipe lines in the postwar period. Overshadowing the completed projects was the enlargement and projection of the Great Lakes Pipe Line System.

The Great Lakes System prewar extended north from the Tulsa, Oklahoma area via Kansas City and Des Moines to Minneapolis, Minnesota with branches from Osceola, Iowa, to Omaha, Nebraska, and from Coralville, Iowa, to Chicago, and could transport a maximum of 49,250 bbl daily when handling all gasoline. The company late in 1945 embarked upon a major construction program that culminated in 1947 by placing in operation some 1273 miles of new lines that raised the carrying capacity to 85,700 bbl per day into Kansas City. The work consisted of building a 204-mile 8-in. parallel line between Barnsdall, Oklahoma and Kansas City, Kansas, a 568-mile 8-in. line from Kansas City, via Omaha, Sioux City, Sioux Falls, and Fargo, to Alexandria, Minnesota, with a 180-mile 6-in. extension to Grand Forks, North Dakota. A 71-mile 6-in. branch was built from Marshall, Minnesota to Watertown, South Dakota, and a 62-mile 6-in. branch from Albert Lea to Mankato, Minnesota. New feeder lines consisted of a 86-mile 8-in. line between Eldorado and Humboldt, Kansas, a 13-mile 8-in. line between Argentine and Kansas City, Kansas, a 54-mile 8-in. line between Ponca City

Statistics of interstate oil pipe line companies

The following is a comparison of selected financial and operating data of 71 pipe line companies reporting to the Interstate Commerce Commission at the close of the years 1941 and 1947 (in general the same companies):

	1941	1947	Increase or decrease
Miles of line operated:			
Gathering lines	41,858	45,909	+ 4,051
Trunk lines	63,577	73,389	+ 9,812
Total	105,435	119,298	13,863
Investment in carrier property	$ 885,316,742	$1,225,168,434	+$339,851,692
Accrued depreciation—carrier property	468,447,755	647,123,151	+ 178,675,396
Capital stock	254,614,453	233,815,067	— 20,799,386
Funded debt unmatured	37,906,941	105,543,388	+ 67,636,447
Total current liabilities	90,569,757	105,067,279	+ 14,497,522
Total surplus	30,393,926	147,836,483	+ 117,442,557
Operating revenue	251,684,772	325,223,884	+ 73,539,112
Operating expenses	110,448,441	214,681,999	+ 104,233,558
Pipe line taxes:			
U. S. Government	50,042,248	44,369,699	— 5,672,549
Other than U. S. Government	9,590,488	11,757,038	+ 2,166,550
Total	$ 59,632,736	$ 56,126,737	—$ 3,505,999
Barrels of oil transported (received into system):			
Crude oil	1,531,862,440	2,236,085,277	+ 704,222,837
Refined products	106,840,984	245,775,242	+ 138,934,258
Total	$1,638,703,424	$2,481,860,518	+ 843,157,095
Number of barrel-miles having trunk line movement (thousands)	350,785,208	537,058,744	+ 186,273,536

and Barnsdall, Oklahoma, and a 35-mile 8-in. line between West Tulsa and Drumright, Oklahoma. In addition the company purchased a 29-mile 4-in. line between Arkansas City, Kansas, and Ponca City, Oklahoma. In the rearrangement of the system, the company retired about 261 miles of 4, 6, and 8-in. lines, including the branch from Osceola, Iowa, to near Omaha, Nebraska.

Another important addition was the construction in 1946 and 1947 by the Standard Oil Company (Indiana) of a 662-mile 8 and 10-in. line from Whiting, Indiana, via Joliet and Minneapolis, to Moorhead, Minnesota, near Fargo, North Dakota. This line has a 10-in. pipe between Whiting and Minneapolis and 8-in. beyond.

Three new products pipe lines have been laid in the Dallas-Fort Worth area.

The Humble Pipe Line Company completed in 1946 a 280-mile 8-in. line from the Baytown, Texas, refinery of the Humble Oil and Refining Company to Irving (between Dallas and Fort Worth). This line can handle 30,000 bbl daily and has take-off terminals at Houston, Hearne, and Waco.

Magnolia Pipe Line Company completed in 1947 a 178-mile 12-in. line from Beaumont to Hearne, Texas, which connects with a 172-mile 8 and 10-in. line constructed by The Texas Pipe Line Company from Hearne to Grand Prairie (between Dallas and Fort Worth). This latter line connects with a new 107-mile 6 and 8-in. line built by The Texas Pipe Line Company from San Marcos, via Austin, to Hearne, Texas. A 52-mile 6-in. line between San Marcos and San Antonio, Texas, formerly in crude service, was converted to handle products.

The Sinclair Refining Company completed in 1947 a 225-mile 6 and 8-in. line from Corpus Christi, via San Antonio and Austin, to Bryan, Texas, together with a 50-mile 6-in. line from San Antonio to Luling, Texas. These lines connect at Bryan with a new 264-mile 10-in. line completed in 1948 by Sinclair Refining Company from Houston to Arlington, Texas (between Dallas and Fort Worth). This latter line has recently been extended from Arlington, Texas, to Pauls Valley, Oklahoma, by laying a 177-mile 8-in. line. The company is now engaged in converting a 560-mile 8-in. crude line between Pauls Valley, Oklahoma and Wood River, Illinois, and also a 20-mile 6-in. line between Redel and Kansas City, Missouri, to handle refined products. It will likewise convert a 375-mile 8-in. line between East Chicago, Indiana and Carrollton, Missouri, from crude to refined products service. When completed this will be the first pipe line to deliver refined products from the Gulf Coast to Chicago and St. Louis.

The Socony-Vacuum Oil Company, Inc., completed in 1946 a 309-mile 8, 10 and 12-in. line from Paulsboro, New Jersey, to Midland, Pennsylvania, together with 17 miles of 4-in. spurs to Lancaster, Harrisburg, Altoona, and McKees Rocks bulk terminals. This line is now being extended 154 miles from Malvern, Pennsylvania to Binghamton, New York, to connect with an existing system projecting from Buffalo, New York.

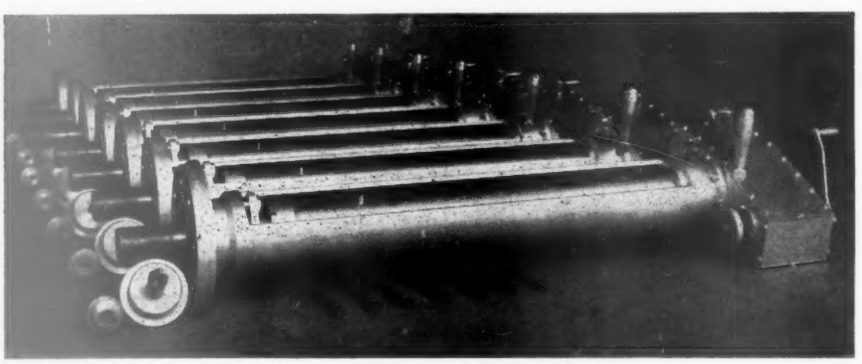
Sinclair Refining Company tied in its existing East Chicago-Toledo and Philadelphia-Steubenville systems by constructing 228 miles of 6-in. line between Toledo and Steubenville, Ohio, via Columbus. It also built a 56-mile 6-in. line from Toledo, Ohio to Detroit, Michigan, and a 225-mile 6-in. line from Marion to Cleveland, Akron, and Youngstown, Ohio.

By a joint ownership arrangement the Phillips Petroleum Company and Shamrock Oil and Gas Corporation built in 1947 a 200-mile 6-in. line from Borger, Texas, via McKee, to La Junta, Colorado. This line is to be extended to Denver, Colorado. That portion of the line, 37 miles, between Borger and McKee, Texas, is wholly owned by Phillips and the balance is jointly owned.

Wood River Oil and Refining Company completed in 1947 a 67-mile 8-in. line between Peru and Rockford, Illinois. The Peru terminal has facilities for unloading products received via barges operating on the Mississippi River loaded at its Hartford, Illinois refinery.

The Wyco Pipe Line Company, owned jointly by Standard Oil Company (Indiana), The Texas Company, and Socony-Vacuum Oil Company, Inc., completed in 1947 a 268-mile 6 and 8-in. line from Casper, Wyoming, via Cheyenne, to Denver, Colorado. The line has a capacity of 32,300 bbl daily, of which approximately 13,000 bbl are for Denver delivery.

The Triangle Pipe Line Company completed in May, 1948, a 43-mile 8-in. line from Carthage, Texas, to Shreveport, Louisiana, to handle 20,000 bbl per day. This line connects with existing lines at Shreveport and will move products into El Dorado, Arkansas, where delivery will be made to Project Five Pipe Line extending to Helena, Arkansas for further movement by barges operating north on the Mississippi River. * * *



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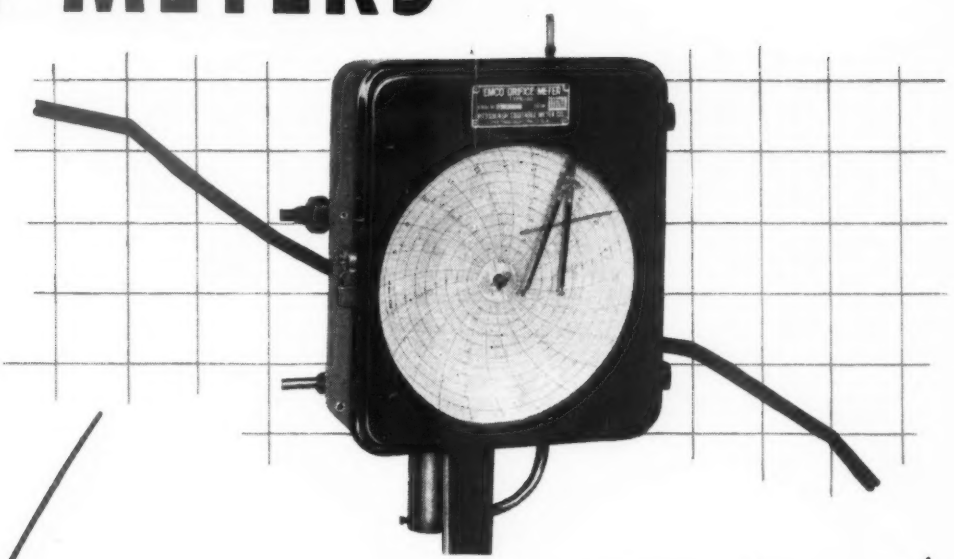

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Management Information on Cathodic Protection

SPONSORS

Eleven nationwide organizations sponsored the preparation of this bulletin, which was prepared by the Correlating Committee on Cathodic Protection. The purpose of the committee is to promote better understanding of cathodic protection and foster needed cooperation among operators of all types of buried structures in its beneficial application. Three additional bulletins also are being prepared. No. 2 will define a practical procedure for inter-operator notification. No. 3 will assist corrosion engineers in the technical aspects of cathodic protection coordination. No. 4 will treat with "joint systems."

The organizations participating are American Gas Association, American Petroleum Institute, National Association of Corrosion Engineers, Association of American Railroads, American Public Works Association, American Water Works Association, Edison Electric Institute, International Municipal Signal Association, U. S. Independent Telephone Association, Bell System, and Western Union Telegraph Company. Chairman of the Correlating Committee is H. H. Anderson, Shell Pipe Line Corporation, representing the American Petroleum Institute. The secretary is F. E. Dolson, Jr., St. Louis County Water Company, representing the American Water Works Association.

CORROSION of buried plant and its contingent losses are costing American industry about a billion dollars per year. Much of this loss can be stopped by proper preventive measures.

These enormous losses and the problems of preventing them are shared in different form and degree by all operators of water, gas, and oil lines, communications, signal and power cables, rail tracks, tanks, equipment foundations, and other metallic structures buried or in contact with the soil or water.

Corrosion of buried structures is simply a chemical attack by Nature, which attempts to revert refined metals to their original form as ores or compounds. This chemical attack always goes hand-in-hand with a flow of electric current from the metal. In most cases a chemical attack causes the current flow but, conversely, a flow of impressed current from metal into soil causes chemical attack. If such current out-flow can be prevented, corrosion cannot occur.

Regardless of whether the attack initiates the current flow or vice versa, the corrosion damage is physically similar; and a current out-flow of one ampere in one year accompanies a loss of as much as 20 lb of iron or steel, or 70 lb of lead.

Corrosion prevention properly starts with the design of structures and equipment, including the selection and placement of materials—in particular avoiding the contact of dissimilar metals—so as to minimize corrosion possibilities. During plant construction and subsequent operation, much corrosion can be prevented by avoiding the disposal of waste matter where it may unnecessarily pollute the soil in or near the plant. In concentrated operating areas, effective surface drainage will minimize the likelihood of soil pollution.

The attention of industry was directed, even before 1900, to the corrosion of buried pipe and cable near electrified street railway tracks by the currents that "strayed" into these structures from the rails. The pipes and cables were corroded where these currents left them via the soil en route back to the current source. This type of corrosion is called "electrolysis."

Joint engineering committees in many metropolitan areas, through a fine spirit of cooperation, have effectively minimized the damage due to stray current electrolysis. The customary technique is to keep the stray currents as low as possible, and to provide continuous metallic paths through which they will flow back to their source.

Though not initially recognized as beneficial, these currents, when strong enough, stopped corrosion where they strayed into the other structures because they prevented the out-flow of the weaker currents attending such corrosion. This electrical counteraction is the basis of the rapidly developing technique of cathodic protection.

In numerous areas where transit companies have abandoned electrified track, operators of other structures are finding that the removal of the stray railway currents has allowed the weaker currents of natural corrosion to flow unopposed. The cathodic protection before provided in various degrees by the stray currents has been removed!

Outside of the geographically small metropolitan areas, different problems are presented. Corrosion of buried structures is widespread unless it is prevented. Among the accepted preventive techniques are properly engineered coatings or cathodic protection, or a combination of the two.

If a structure could be coated with an impervious and durable layer of electric insulating material, all flow of current to or from the soil would be prevented. Inasmuch as the soil and moisture would be separated from the structure, corrosion could not occur.

Although excellent coatings now are available that will provide reasonable protection if carefully applied, some of them will deteriorate or become damaged in time. Such coating defects tend to focus corrosive action and hasten structure damage locally.

Early structures were buried bare, and many coatings applied on other structures prior to the last decade have little if any protective value now. To coat or recoat these operating structures — which usually requires that they be uncovered, raised and cleaned —is difficult and expensive, and often impractical.

For reducing corrosion on older structures, or insuring continued protection with newer coatings, the use of cathodic protection is indicated. Specifically, this is the technique of impressing inward-flowing currents to counteract, and thus prevent, the outward-flowing currents of natural corrosion. Where cathodic protection is applicable, it has the special advantage that it can be installed with very little disturbance of the structures.

To apply cathodic protection requires continuous supplies of protective current. It requires also, to be buried in suitable ground beds at appropriate distance from the structure, one or more masses of metal or carbon (called "anodes") through which this current can be introduced into the soil. For this current to serve its purpose as it fans out through the soil and distributes itself along the structure, it must be of sufficient strength or density to enter the structure and counteract the harmful corrosion currents.

Two types of protective current source may be used. Where considerable current is required, it may be obtained from direct-current generators or rectifiers connected by insulated wires positively to the anodes and negatively to the structure. For the introduction of external currents through the soil into the structure.

anodes of graphite rod, or of scrap cast-iron or steel are customarily used.

Where less protective current will suffice, anodes can be used that will self-generate the needed current. When masses of magnesium, aluminum, or zinc are buried and connected to a steel or lead structure by insulated wires, they will generate current (as in a battery), which will flow through the soil into the structure.

All types of anodes will be corroded by the protective current that they discharge to the soil, and they must be renewed at intervals; however, under favorable conditions, these anodes may last several years before replacement is necessary.

Some of the current introduced at the anodes to cathodically protect one structure may enter a neighboring structure and traverse it for a distance while en route to the protected one. Where this current leaves the neighboring structure and enters the soil, corrosion occurs that is similar to street railway stray current electrolysis. It can be prevented in several ways, one of the commonest of which is to connect the neighboring structure to the protected one by a wire "drainage bond" of proper resistance.

Mileage of buried structures in the United States.

(According to best available estimates)

Pipe		988,000 mi.
Gas lines	321,000 mi.	
Natural gas	228,500 mi.	
Manufactured gas	71,200	
Mixed gas	18,500	
Liquefied petroleum gas	2,800	
Water lines	250,000	
Oil lines	150,000	
Crude oil	133,500	
Products	16,500	
Miscellaneous oil country pipe	267,000*	
Steel track		425,000
Railroads	406,500	
Transit lines	18,500	
Metal-sheathed cable		167,000
Communications and signal systems	92,000	
Electric power distribution	75,000	
Total		1,580,000 mi.

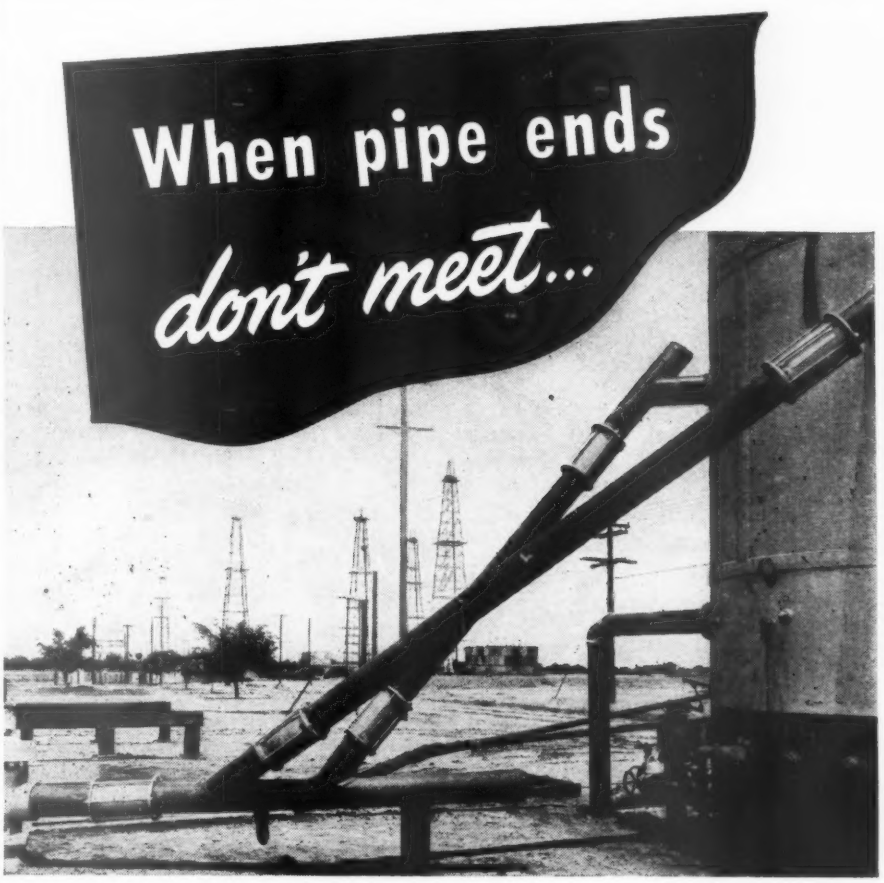
*Note: This figure is based on a 17.5 per cent sampling of field operations.

Because of this possibility of interaction, any operator planning a cathodic protection installation should notify operators of neighboring buried structures so that all concerned can appraise the interaction problems. Experience shows that these can be dealt with most effectively and satisfactorily through cooperative study and tests by engineers of the operators involved.

The foregoing paragraph applies to conditions where cathodic protection is designed primarily for the structure (or structures) of a single operator. Frequently, however, where reasonably adjacent structures of two (or more) operators are subject to similar corrosion damage, "joint cathodic protection systems" can be designed, installed, and operated economically to the benefit and satisfaction of all concerned.

The fundamentals of cathodic protection are relatively simple, but solution of its technical and economic problems requires a high degree of engineering skill. The harmony in which metropolitan engineers have coordinated their complex electrolysis problems sets the pattern for the cooperation needed to deal with local cathodic protection problems in the field. These call for a business judgment by all concerned, and an approach based on mutual appreciation of the obvious equities and resultant benefits.

The use of cathodic protection offers widespread opportunities for reducing the enormous losses incident to underground corrosion, and its application requires cordial intercompany relations. Thus it is good business for all managers of buried plant to be generally informed about, and to give sympathetic support to, their engineers dealing with the application of cathodic protection. ★ ★ ★



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Pipe Line Marine Transportation Personals

▸ **Charles S. Coates** was elected a vice president of the Tennessee Gas Transmission Company, Houston, Texas, at a recent meeting of the board of directors. He will continue with his duties as general superintendent, it is announced.

▸ **Mark A. Leonard**, Texas-Gulf area chief dispatcher for Shell Pipe Line Corporation, has been retired, closing a Shell career that began 29 years ago as dispatcher at Cushing, Oklahoma. He was made chief dispatcher there in 1925 and was transferred to Austin, Texas, in the same capacity in 1929. He has been in Houston since 1934.

▸ **Louis F. Kirchoff** has been made pipe line division superintendent at Bushton, Kansas, for Northern Natural Gas Company, to fill a vacancy caused by the death of **Al During.** Kirchoff began work with Northern Natural as a laborer at Bushton and has been a truck driver, utility man, tractor driver, inspector on construction jobs, and most recently district foreman.

▸ **James D. Bryan,** formerly assistant district engineer in the Jackson district, for United Gas Pipe Line Company, has been transferred to the Shreveport general office as assistant chief draftsman.

▸ **Robert W. McKennon**, formerly utility man at Stamford, has been made sub-district manager at Baird, Texas, for Lone Star Gas Company. He succeeds **W. W. Lofland,** who has been transferred to the Abilene district office as storekeeper.

▸ **P. F. Williams,** Houston, Texas, who has been chief engineer for the Pan American companies, which includes pipe line, gas, and production, has resigned to accept a position as chief engineer for the Venezuelan Atlantic Refining Company, Caracas, Venezuela. **J. O. Phillips**, who was Williams' assistant, is now engineer in charge.

▸ **Capt. T. C. Conwell**, well known tanker operator, has been appointed manager of Independent Tankships, Inc., wholly-owned subsidiary of American Independent Oil Company, it is announced by **Ralph K. Davies,** president of American Independent. He will divide his time between the San Francisco and New York offices of the company, which owns six tankers.

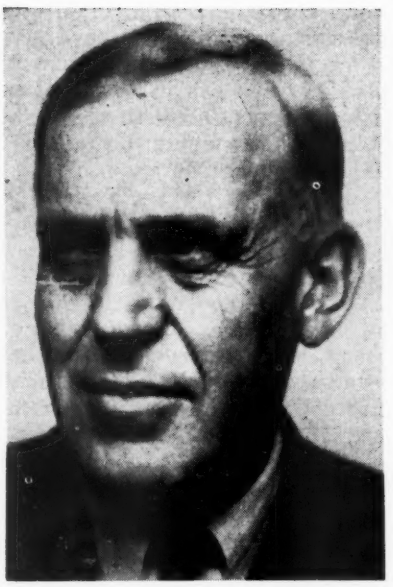
▸ **Charles H. Kunze**, who was general manager of the Marine Transportation Department of the Socony-Vacuum Oil Company until he retired in 1946, died recently in the Swedish Hospital, Brooklyn. He was well known in the oil transportation industry, having entered the employ of the Standard Oil Company in 1904, and after holding various positions in the company, was appointed general manager of marine transportation on December 1, 1941. During the war he was also executive vice president of War Emergency Tankers, Inc., and a member of the Supply and Transportation Petroleum Industry Committee. He was a member of the American Bureau of Shipping, Lloyd's Register of Shipping, New York Produce Exchange, Maritime Association of the Port of New York, and the American Petroleum Institute.

▸ **Robert Gregg,** for more than 27 years a member of the Standard-Vacuum Oil Company's marine sales division at Shanghai, China, is now en route to his home address at 33 Church Street (E), Belfast, Ireland, pending his retirement in January under the company's pension plan.

Preceded by Mrs. Gregg and their two children, Gregg left Shanghai on October 14 for Vancouver, Washington, U.S.A., where he will join his family for the trip to Halifax by train and Belfast by boat.

The Greggs were among the many members of Shanghai's foreign colony who were interned by the Japanese during the recent war. The family spent 32 months, from March, 1943, to October, 1945, interned at the Chapei Civil Assembly Center, Shanghai. After a special six-month rest and rehabilitation leave at home, the Greggs returned to China.

Gregg has been steadily assigned to the Standard-Vacuum Shanghai office, 94 Canton Road, since his employment there in April, 1921. He had originally gone to the Orient as a marine engineer.



Starr Thayer

Pipe Line Personality

WHEN the subject of cathodic protection arises Starr Thayer is quite often thought of as being the "Daddy" of this method of protecting underground structures from corrosion. He hastens to tell you when asked, however, that such is not the case.

"A book was published on the subject away back in the early 1900s when I was still in school," he informs you. It should be added, however, that whereas the book related to electrolysis of steel, it did not apply the known facts to pipe line usage, and Thayer had much to do with adapting the art to this purpose. He has, in fact, been a leader in this, as well as other phases of pipe line protection, and is regarded as very much of an authority on the subject. His achievements in the field, moreover, include a number of "firsts."

One of these was the installation of the first complete cathodic protection unit; that is, one having its own ground bed as well as power unit. This installation was made in 1932 between Baton Rouge and New Orleans, Louisiana, on the system of the United Gas Pipe Line Company. Additionally, his studies of pipe line coatings and wrappings were among the first to be made on a scientific basis, and one result of his interest in the subject was the devising of the first electric holiday detector, which was in collaboration with Al Smith and S. U. McGary.

His interest in pipe protection, however, is not confined to a desire for personal accomplishment, but extends to include a wish to benefit the pipe line industry as a whole. Such a feel-

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WHEN IT COMES TO PIPELINES COME TO

FRANK W WHEATLEY

FRANK WHEATLEY PUMP & VALVE MFRS. — TULSA, OKLAHOMA

ing led, in the early 1930s, to the organization, together with L. F. Scherer, of the first meeting for the study of cathodic protection as a group. The meeting was held in the directors room of The Texas Company in Houston and resulted in the organization of the Mid-Continent Cathodic Protection Association, from which developed the present National Association of Corrosion Engineers.

Thayer was born in Rock Valley, Iowa, in 1886, finished high school there, and was graduated from Iowa State College at Ames in 1908 with a degree in electrical engineering. In the years following his graduation he was connected with the Seattle Electric Company and the Montana Power Company. When World War I came along he enlisted in the Corps of Engineers. After the war ended he remained in France a year, or until the Fall of 1919, in charge of selling government property.

Returning to the United States, he was engaged for a number of years in building electric power plants in the South. In 1926 he moved to Houston, Texas, to install the electrical equipment for an electric railroad between Houston and Goose Creek, remaining after its completion in an operating capacity.

He joined United Gas Pipe Line Company, which then had its headquarters in Houston, in 1930, to take charge of, or rather to establish, a corrosion department. In this work his previous experience stood him in good stead. He had, in fact, done electrolysis work as far back as his Seattle days. This gave him a basic knowledge that could be applied to the protection of pipe lines. He left United in 1937 to open a consulting office in Houston.

Thayer takes an active interest in sports, particularly football, which he comes by naturally enough, having played guard on the Iowa State team and being an All-Western selection his senior year. Of interest, inasmuch as Thayer today is a follower in particular of Southwest Conference teams, outstanding proponents of aerial football, is the fact that the pass was just coming into use during his playing days. So new was it, in fact, that the ball was not thrown as it is today, but was held in a half-encircled manner by the hand and forearm and tossed with a sort of overhand or lobbing motion. This practice, however, was soon discarded, Thayer says, for a more effective method, one resembling that employed today.

Thayer's other athletic accomplishment while in college, and we should mention it while on the subject of sports, was in the realm of track—for many years he held the Iowa state discus record.

Since entering consulting work Thayer's services have been in demand by leading pipe line companies in the United States and in foreign countries. His activities among the latter have been in Colombia, Dutch West Indies, and Mexico.

▸ **C. F. Rittman, Jr.,** formerly chief measurement engineer of El Paso Natural Gas Company and editor of *The Pipeliner,* company publication, has been appointed superintendent of measurement. **Jack Purvis,** who has been chief instrument engineer, has been named chief meter inspector. **George O. Cragin** formerly measurement engineer, is now chief measurement engineer. B. Marshall Willis, who has been assistant editor of *The Pipeliner,* has been appointed editor.

▸ **Roy C. Van Houten** has been appointed service foreman for Wichita Falls, Texas, by the Lone Star Gas Company, succeeding **Glen Clem.** Van Houten joined Lone Star in 1941 as a skilled laborer and became a utility man in 1943, which position he held until he joined the Army in May, 1944. He returned to the company October 1, 1945, and was promoted to service man May 1, 1946.

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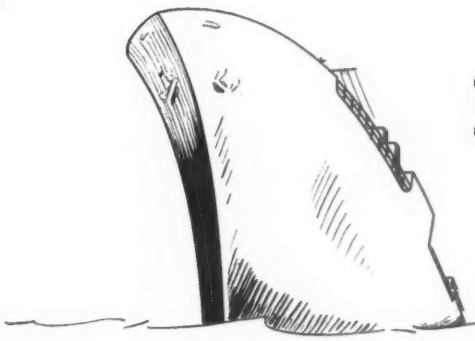

MARINE OPERATIONS

SNA&ME Holds Meeting And Elects New Officers

At the annual meeting of The Society of Naval Architects and Marine Engineers, held on November 10 to 13, inclusive, new members were elected, making the total membership 5528. This is the highest total ever reached in the 56-year history of this marine technical society.

John B. Woodward, Jr., president of the Newport News Shipbuilding and Dry Dock Company, was elected president of the society for a two-year term, succeeding Vice Admiral Edward L. Cochrane, USN (retired).

Election of officers to fill vacancies and terms expiring resulted in the selection of the following slate:

Honorary vice presidents — Arthur B. Homer and Roger Williams.

Vice presidents for term ending December 31, 1951—*C. W. Middleton, Harold E. Saunders, *George G. Sharp, and *Henry Williams.

Vice president for term ending December 31, 1949—David Arnott.

Vice president for term ending December 31, 1950—Earle W. Mills.

Council members representing members and associate members for term ending December 31, 1951—Walter L. Green, *James B. Hunter, *Harvey F. Johnson, *John F. Nichols, *W. Selkirk Owen, and *S. A. Vincent.

Council member for term ending December 31, 1949—Charles D. Wheelock.

Council members for term ending December 31, 1950—William Francis Gibbs, Daniel D. Strohmeier, and O. B. Whitaker.

Council members representing associates for term ending December 31, 1951—*B. F. Campbell, *Harold S. Falk, and Albert V. Moore.

Treasurer—O. B. Whitaker.

Secretary—*Wilbur N. Landers.

Assistant treasurer—C. C. Knerr.

Assistant secretary—*Arlo Wilson.

Editor—*H. H. Brown.

The 1949 executive committee consists of J. B. Woodward, president, ex-officio, David Arnott, W. E. Blewett, Jr., Edward L. Cochrane, Homer L. Ferguson, Walter C. Hemingway, J. H. King, Emory S. Land, Emmet J. McCormack, John F. Metten, C. W. Middleton, Earle W. Mills, William S. Newell, Joseph W. Powell, H. Gerrish Smith, and O. B. Whitaker, treasurer ex-officio.

*Incumbent.

Record Canal Movement

More petroleum has been moved through the New York State Canal System during 1948 than was ever moved in previous periods, according to the New York State Department of Public Works. Petroleum shipments in the canal now total 2,923,438 tons as compared with the previous record of 2,651,256 tons established during the 1947 season. Tonnages making up recent canal shipments included, petroleum, 92,397; wheat, 19,450; pulpwood, 9,923; scrap iron, 7,055; chemicals and drugs, 3,765. Cargoes moved through the week ending November 6 totaled 140,000 tons, a gain of 3,020 tons over the corresponding week a year ago.

Launch "British Yeoman"

The single screw motor tanker *British Yeoman*, at the Haverton Hill Shipyard of Furness Shipbuilding Company, Ltd., is the eighth tanker to be built for British Tanker Company, Ltd. The builders have orders for two similar tankers for the same owners. The *British Yeoman* is of the poop, bridge, and forecastle type with machinery fitted aft, and is constructed to Lloyds highest class under their special survey for carrying petroleum in bulk. Her principal dimensions are: Length overall, about 490 ft 10 in.; breadth moulded, 61 ft 9 in., and depth moulded, 33 ft 11 in.

A deadweight of 12,250 tons will be carried on a summer draught of 27 ft 6 in., the designed service speed being 11½ knots.

The vessel is built on the combined system of transverse and longitudinal framing with raked stem and cruiser stern.

French 16,000-ton Tanker

The Odense shipyard has recently launched the *Novice Le Maud*, a 16,000-ton tanker, for French account. A sistership to the *President Meny*, which was launched last February, the tanker is second of a series of three. A 12 in. pipe line, about 4.3 km long, has been laid at Frontignan, near Sete, France. It connects the oil refinery of Cie Industrielle des Petroles with the berthing accommodation and will enable the largest tanker to be unloaded in a few hours.

Says Adequate Tanker Supply Depends on Mid-East Pipe Lines

Supply of existing tankers including those scheduled to be built within the next four years will be adequate to meet oil transportation requirements, but only if the big projected Middle East pipe lines are completed on schedule, according to M. G. Gamble, manager, marine department of Standard Oil Company of New Jersey.

In a statement released, simultaneously in New York and in Chicago where Gamble attended the American Petroleum Institute convention, the Standard Oil Company executive cited that 400 equivalent T-2 type tankers are scheduled for delivery within the next four years and that his company estimates total tonnage will "very closely balance world transportation needs during those years," provided the Middle East pipe lines are built. He estimated that an additional 80 T-2 tankers would be needed to carry the 330,000 bbl of oil daily that will be moved by the Trans Arabian pipe line to the Mediterranean after its scheduled completion in January, 1951. Another 132 T-2's would be needed to replace the second big pipe line from the Persian Gulf, which is scheduled for completion in 1953 with capacity of 530,000 bbl daily. Gamble believed that the critical period of the world tanker situation is behind, and that with the help of the pipe lines, industry "can be depended upon to meet all anticipated commercial tanker needs under peacetime conditions."

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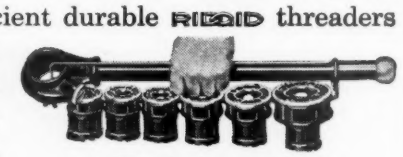

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To Merge Berths for Tankers

Six vessels are due for launching from the Sunderland yard of John Crown and Sons, Ltd., England, before a start is made on the construction of the Norwegian tanker of 23,000 tons deadweight that the firm has on order for Olsen and Ugelstad of Oslo, Norway. It is reported that the keel of the first section of the vessel, which is to be built in two halves, will be laid about 1950, and both berths of Crown and Sons will be merged for this purpose, because of the wide beam of the vessel. When both sections have been launched, they will be joined in the South Shields dock of the Middle Docks and Engineering Company, Ltd. The tanker is one of three similar vessels now on order on the Wear, and are the largest vessels ever on the books of Sunderland shipbuilders.

Sun Adds Coastal Tankers

Sun Oil Company is putting into service two new coastal tankers to expedite increased shipments of gasoline from its Marcus Hook refinery. Built for the Navy as auxiliary oilers, the tankers were purchased from the Maritime Commission and converted to Sun Oil's specifications at Bethlehem Steel Company's shipyards at Alameda, California. The vessels have been renamed the *Mystic Sun* and the *Maumee Sun*. Each is 220 ft long and has a capacity of approximately 500,000 gal of gasoline. Powered by 860-hp diesel engines, they have a rated speed of about 10 knots.

Tanker Flue Gas System

Based on the evident good results of the trial system on the *Petersburg*, the Keystone Shipping Company is preparing to install the combined Cargocaire dehumidified air and flue gas system for a complete ship in another of the tankers which the company operates. The Sun Shipbuilding and Dry Dock Company of Chester, Pennsylvania, and the Sun Oil Company, pioneered the development of flue gas systems for tankers, having completed research on a practical design to combine the corrosion-prevention of dehumidification and the explosion-prevention of inert flue gases by removal of water vapor from them.

Coast Guard Initiates New Inspection Plan

The U. S. Coast Guard has inaugurated a merchant marine industry training program to acquaint officers of the Bureau of Marine Inspection and Navigation with problems of operating American tanker, cargo, and passenger fleets. Three officers already have been assigned for a one-year tour of duty with The Texas Company, Standard Oil Company of New Jersey, and Standard Oil Company of California. During their year of service, the men will be paid by the Coast Guard, but will work as employes of the company to which they are assigned. The training program is designed to "encourage greater cooperation between industry and the Coast Guard and to broaden the understanding of merchant vessel problems from a commercial point of view, thereby facilitating a balanced administration and supervision of marine inspectional activities by qualified Coast Guard personnel."

Integrated Tank Barges

Integrated tank barges of an entirely new design will be built by Dravo Corporation for the Mid-Continent Barge Line Company, Minneapolis, Minnesota, for the transportation of petroleum products on the inland waterways.

It was stated that, due to advanced design, careful engineering and precision testing, the new hull form of this unit will have the lowest ton-mile resistance of any such fleet built by Dravo Corporation.

Each of the two barges will be 240 ft long, 50 ft wide, and 12 ft deep. Together the barges will have a capacity of more than 40,000 bbl of gasoline.

Pipe Line Contractors First Annual Meeting

Representatives of the 27 members of the pipe line contractors association met in a two-day annual meeting at the Mayo Hotel in Tulsa, Oklahoma, November 16 and 17. Also attending the meeting were representatives from 31 associate members of the organization.

The Mid-Continent Pipe Line Chapter is an affiliate of the Associated General Contractors of America, Inc., and is composed of 27 pipe line contracting firms. These firms specialize in the construction of cross-country oil, gas, and gasoline pipe lines. The Mid-Continent Pipe Line Chapter was organized in January, 1948, and the meeting in Tulsa was its first annual meeting.

Highlight of the meeting was a talk by James D. Marshall of Washington, D. C. Problems affecting the pipe line contracting industry as a whole were discussed and committees were appointed to study specific proposals made during the meeting.

Newly elected officers and directors of the association are:

President—T. A. Hester, Oklahoma Contracting Company, Inc., Dallas, Texas.

Vice presidents—J. R. Horrigan, J. R. Horrigan Construction Company, Inc., Houston, Texas; Ray L. Smith, Ray L. Smith & Son, Inc., El Dorado, Kansas.

Treasurer—James P. Neill, H. C. Price Company, Bartlesville, Oklahoma.

Directors—F. E. Stanley, Midwestern Constructors, Inc., Tulsa, Oklahoma; C. S. Foreman, C. S. Foreman Company, Kansas City, Missouri; J. C. Britton, Britton Contracting Company, Inc., Fort Worth, Texas; Robert D. Sheehan, Sheehan Pipe Line Construction Company, Tulsa, Oklahoma; N. A. Saigh, N. A. Saigh Company, Inc., San Antonio, Texas; E. G. Morrison, Morrison Construction Company, Inc., Austin, Texas, and Robert Thomas, O. C. Whitaker Company, Fort Worth, Texas.

Richard A. Gump, Dallas, Texas, was re-elected executive secretary of the chapter.

Pipeliners Club of Tulsa Organized

Ten major pipe line companies in the Tulsa area are represented in the membership of a newly organized technical and operating club known as The Pipeliners Club of Tulsa.

The club is now functioning through monthly dinner meetings, which have been held thus far in Tulsa, but with some sessions to be conducted in other cities in the territory.

Membership qualifications are based on active engagement in pipe line engineering, consultation, evaluation or design, and responsible supervision of construction or operation of oil, gas, and products pipe lines. Associate memberships, to a limited number, are afforded suppliers.

The purpose of the club is the interchange of ideas, practices, and general information concerning pipe line problems. Technical or operational papers, followed by discussion periods, will be presented at the monthly sessions.

Officers and directors elected for the year 1948-1949 are:

President: J. L. Cahill, chief engineer, Continental Pipe Line Company, Ponca City.

Vice president: P. L. Reichard, assistant general superintendent, Gulf Refining Co., Pipe Line Division, Tulsa.

Treasurer: F. C. Whiteside, assistant chief engineer, Interstate Oil Pipe Line Company, Tulsa.

Secretary: J. D. Jones, master mechanic, Gulf Refining Company, Tulsa Pipe Line Division, Tulsa.

Board of directors: F. V. Cook, master mechanic, Stanolind Pipe Line Company, Tulsa; G. P. Jennings, chief engineer, Products Pipe Line Division, Phillips Petroleum Company, Bartlesville; J. F. Nickell, general superintendent, pipe lines, Wilcox Oil Company, Tulsa, and S. C. Phelps, chief engineer, Northern Division, Interstate Oil Pipe Line.

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PIPE LIN

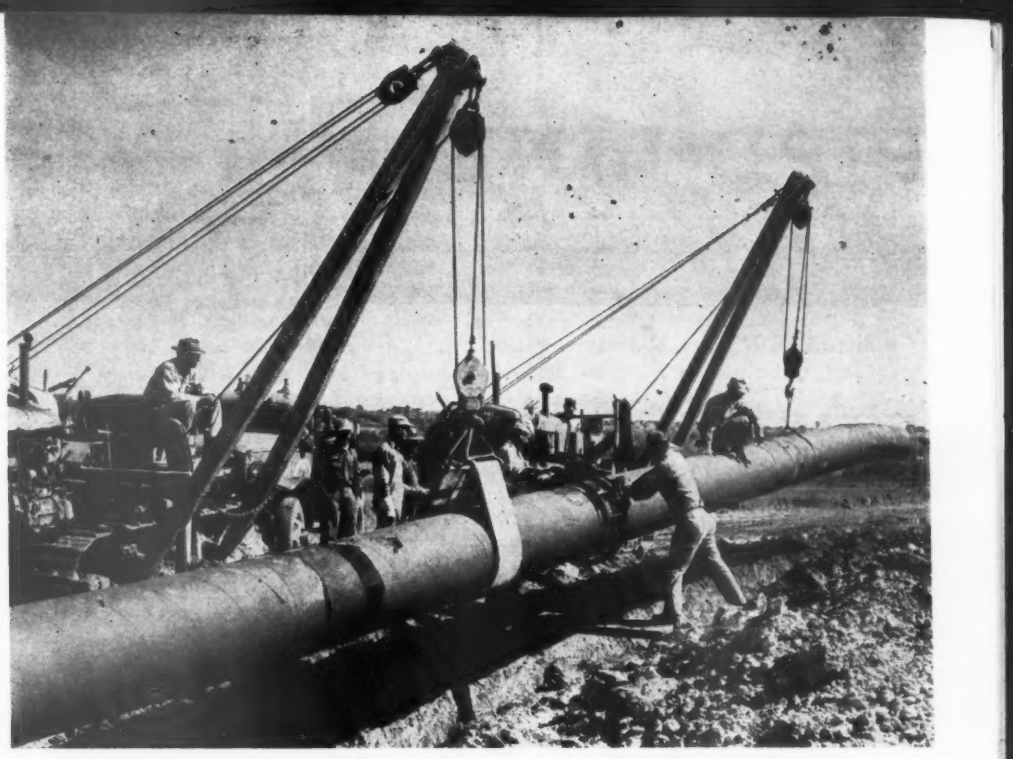
Left, the man with the black box sets off a charge of dy
mite near Kerrville, Texas, to make ditch from the Hun
Pipe Line Company loop that transports oil from West Te

Operating crew at Paul's Valley, Oklahoma, main line s
tion of Sinclair Refining Company, Pipe Line Departm
Left to right: J. T. Marney, machinist foreman; J. L. Patt
operator; John R. Wilson, machinist helper; R. E. West,
tion chief engineer, and H. J. Crawford, engineer.

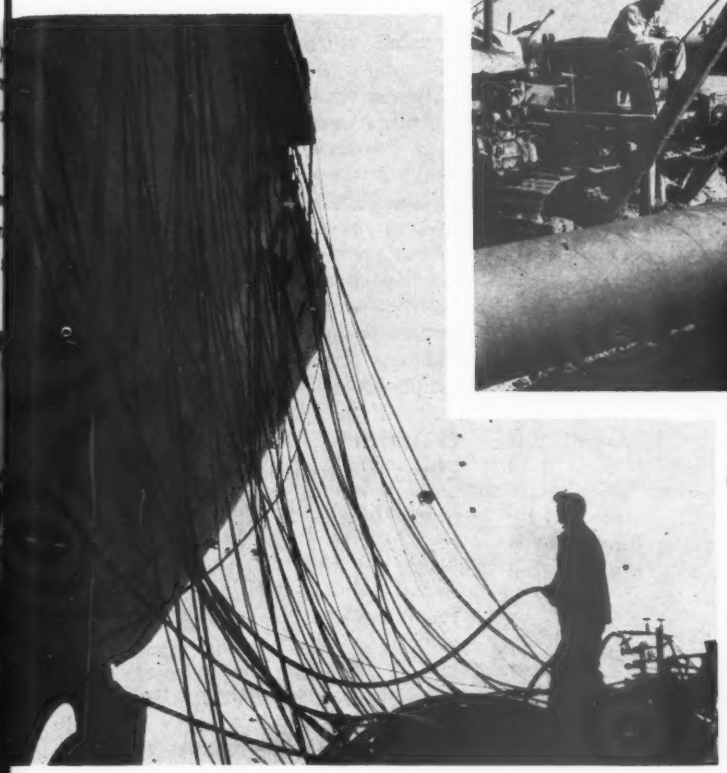
← *Edward S. Plank, Tennessee Gas Transmission Company's gas me*
urement superintendent, a post to which he was recently appointed, replac
E. N. Armstrong. He began work with TGT as field gas engineer four years a

When the photographer visited the Paul's Valley, Oklahoma, station of Stanolind Pipe Line Company the maintenance crew was overhauling an engine. These men, together with the station operating crew, make quite a group. They are, left to right: Gilbert Dorman, operator-gauger-clerk; Jonah Roberts, yardman; Charles Swinney, reliefman; Wayne Roberts, pipeliner; Joe Dulworth, machinist; Jack Stewart, pipeliner; Paul Dennis, machinist; James Wood, machinist; Lee Adams, pipeliner; M. B. Gettys, division machinist; E. H. Votava, utility; N. R. Canaday, chief station engineer; Hiram Hinchey, engineer.

NICTORIAL



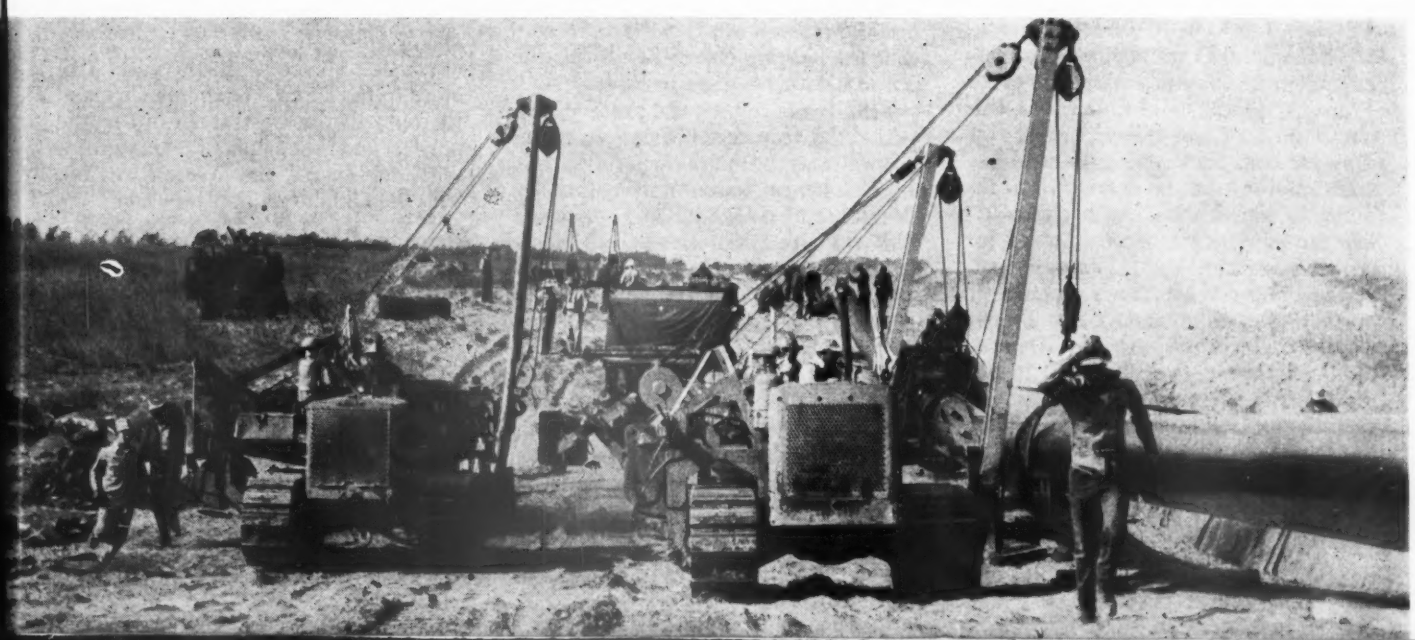
Cutting end off pipe to join up line at road crossing—Kansas City to Ottawa line of Cities Service Gas Company. Contractor was Midwestern Constructors, Inc (See article this issue).



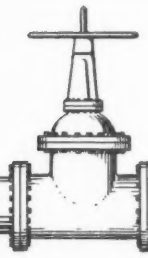
ker under construction at Chester, Pennsylvania, yard of Sun Shipbuilding Company is festooned with miles of welders' line and air hose.

W. G. Frost (left), spread foreman for Ray L. Smith and Son, Inc., contractors, and M. O. Thomas, chief inspector for Cities Service Gas Company, on new line just completed from Hugoton gas field to Hutchinson Kans.

es Service Gas Company lays a 26-in line from sses to Hutchinson, Kansas. The contractor was Ray mith and Son, Inc., El Dorado. (See article this issue.)



PIPE LINE PROJECTS



Ozark System Contracts Let

Contracts for construction of the Ozark Pipe Line System, from Cushing, Oklahoma, to Wood River, Illinois, have been awarded by Shell Pipe Line Corporation, which is in charge of building this 435-mile, 22-in. line for itself and The Texas Pipe Line Company, joint owners. Contracts were submitted in six sections. A description of the sections and names of the contractors to whom the bids were let are as follows:

Section 1, 77 miles from Cushing to the Verdigris River, including dual crossings of the Cimarron and Arkansas rivers, was let to Midwestern Constructors, Inc., Tulsa, Oklahoma.

Sections 2 and 3, 157 miles from the Verdigris River to Roxdale station, including single crossings of the Verdegris and Grand rivers, were let to Smith Contracting Corporation, Fort Worth, Texas.

Sections 4, 5, and 6, 201 miles from Roxdale station, to Wood River, including a single crossing of the Gasconade River and dual crossings of the Missouri and Mississippi rivers, were awarded to Anderson Brothers Corporation, Houston, Texas.

Dredging work on the Missouri and Mississippi river crossings was sublet by Anderson Brothers Corporation to George C. Bolz Company, St. Louis, Missouri. The Missouri River crossing will be made immediately west of Highway 40 bridge at Weldon Springs, Missouri. The Mississippi River crossing will be made immediately south of Hartford, Illinois.

Larger Pipe Authorized

The Federal Power Commission has amended its authorization given to Trans-Continental Gas Pipe Line Company, Inc., of Longview, Texas, last May for construction of a natural gas transmission system extending from Texas to New York City, by authorizing the company to substitute 30-in. pipe for 1210 miles of 26-in. pipe previously authorized. The Commission at the same time authorized Trans-Continental Gas Pipe Line Corporation, a Delaware Corporation, to acquire, construct, and operate proposed facilities of the Trans-Continental Company.

The section of line where the substitution of 30-in. pipe was authorized extends from a point near Opelousas, Louisiana, to Chester Junction, Pennsylvania. FPC also authorized Trans-Continental to substitute 72,000 hp in 10 compressor stations for the 160,000 hp in 15 stations as previously proposed. Deadline for completion of the project, originally set for September 29, 1950, was extended to April 1, 1951.

In its opinion amending the earlier order, the Commission pointed out that the changes in the proposed project would not alter the initial daily delivery capacity of 325,000,000 cu ft in summer and 340,000,000 cu ft in winter, but would permit an increase in ultimate capacity if authorized by the Commission in the future. Estimated cost of the 1,840-mile pipe line project, as now proposed, is $191,310,154.

In authorizing the proposal "to substitute" Trans-Continental Corporation, a Delaware corporation, for Trans-Continental Company, a Texas corporation, the Commission said the "proposed acquisition, construction and operation are required by the public convenience and necessity."

Trunkline Proceedings

The Federal Power Commission has ordered that proceedings on an application by Trunkline Gas Supply Company for authorization to construct and operate a Louisiana-to-Iowa natural gas transmission system are to be continued for not more than six months for the purpose of receiving additional evidence in support of the company's amended application. Trunkline had asked FPC to reconvene the hearing November 15 for the purpose of cross-examination.

FPC, in continuing the proceedings, said "the further hearing contemplated" may be held earlier than six months hence "upon notification by Trunkline of its ability to go forward with the presentation of such additional evidence."

Trunkline, which has main offices in Washington, D. C., and Wilmington, Delaware, proposes to build a 26-in. 768-mile pipe line extending from Lake Charles, Louisiana, to Keokuk County, Iowa. Public hearings on the company's amended application were held in Washington, D. C., from September 8 through 16, and October 18 and 19.

In denying Trunkline's motion for hearing November 15, the Commission said "cross-examination or further hearing is not warranted at this time because of the failure of Trunkline to present evidence which establishes that it has a reasonably assured market for its natural gas, possesses the ability to finance the proposed project, or is able and willing properly to do the acts and to perform the service proposed."

Oklahoma Natural Lines Completed

Oklahoma Natural Gas Company has completed a $3,000,000 pipe line project to take gas from the Golden Trend fields of McClain, Garvin, and Stephens counties. The three main arteries of natural gas lines now linking up are a 16-in. line from Maysville, 66 miles northeast to a point about 6 miles east of Wewoka, connecting with Oklahoma Natural's present 16-in. lines. The second, a 12-in. line, runs from Maysville 34-miles west to a junction near Chickasha connecting with lines moving gas from the Chickasha-Cement producing area to Oklahoma City and other central and northern communities. The third, from Maysville, a 12-in. line, runs 30 miles southwest to Velma in Stephens county where it connects with Skelly's natural gasoline plant, and a 10-in. extension line from Velma some 15 miles southeastward connects the Ardmore district system at a point about 3 miles west of Graham in Carter County.

The completion of this network means the joining of Tulsa, in the northeast, Muskogee in the east, Ardmore in the south, Oklahoma City and El Reno in the west and Enid in the north, and the many communities that intersperse the overall region, with the Oklahoma natural system.

Line to Chicago Proposed

Mississippi River Fuel Corporation has filed an application with the Federal Power Commission for permission to build a natural gas pipe line to Chicago from its present terminus at St. Louis, Missouri. The company expects to be able to make initial deliveries of 100,000,000 cu ft of gas a day to the Chicago market by the fall

of 1951. Eventual capacity of the line is set at 350,000,000 cu ft a day.

The company outlines several proposed steps in its application to the commission. Initially, it asks the FPC to permit it to increase to 24 in. from 22 in., the diameter of the 235-mile final loop that the commission already has permitted it to make to its present Louisiana-to-St. Louis main line. This loop is expected to be completed two years hence. Operated separately with additional compression to step up deliveries, this parallel line is expected to give the company sufficient gas above the needs of its present markets to permit sending 100,000,000 cu ft a day to Chicago.

Mississippi then proposes to build a new line from East St. Louis, Illinois, to Chicago, with 350,000,000 cu ft a day gas-carrying capacity. This new line is to be 210 miles long if it goes to a connecting point with Station No. 10 of Natural Gas Pipeline Company of America, which now supplies the Chicago market. Length of the new line would be 240 miles if it takes an alternate route to Joliet, Illinois, to a junction with Natural Gas Pipeline Company and Chicago District Pipe Line Company.

Mississippi also will build a 450-mile line south to Union Parish in north Louisiana, northwest of the Monroe gas field, to bring in the additional gas supplies needed to provide fuel capacity for its proposed line to Chicago.

Cost of the new facilities is estimated currently at $89,902,250 if the Chicago line terminates at Station No. 10 of Natural Gas Pipeline Company of America and $91,933,680 if the alternate route to Joliet is taken.

Laying Aluminum Pipe

Interstate Oil Pipe Line Company crews in mid-November started construction of 5 miles of 6-in. aluminum pipe line in the sour crude area around Magnolia, Arkansas. The line is being laid from Interstate's Magnolia pumping station as part of the line into McKamie field, Arkansas.

The line is the second section of aluminum pipe to be laid in Interstate's system in the Magnolia area. The first experimental installation, made last April, was watched with considerable interest by representatives of the pipe line and allied industries since it was reported to be the first aluminum pipe to be placed in regular pipe line service.

All construction work is being performed by company personnel, and special attention is being given to the development of practical field procedures for bending, welding, and laying aluminum pipe under actual operating conditions. Prior to the beginning of construction, three Interstate welders were trained to perform the shielded arc welding process used on aluminum pipe by technical experts of the Aluminum Company of America.

Unlike the first section of aluminum pipe, which was laid bare, the new section will be coated and wrapped in the same manner as Interstate's steel lines in the same area. Removable sections are being flanged into the line to provide for future studies of the resistance of the relatively new pipe line material to both internal and external corrosion.

Transportation Agreement

The Tennessee Gas Transmission Company, Houston, Texas, has made a transportation agreement with The Manufacturers Light and Heat Company of Pittsburgh to transport for them approximately 111,000,000 cu ft of gas daily, Gardiner Symonds, president of Tennessee, announces. To do so the company must construct, with approval of the Federal Power Commission, a portion of the facilities for which it has previously applied in connection with its Buffalo extension. Permission has been asked to construct 338 miles of 30-in., 330 miles of 26-in., and 86 miles of 24-in. main line loops, and add approximately 27,200 hp of compression in existing or authorized compressor stations. Estimated cost of these facilities is approximately $65,500,000. The company has finished the presentation of evidence to the Commission supporting this application.

FPC Modifies Authorization

The Federal Power Commission has modified the temporary authorization given to Texas Eastern Transmission Corporation last May for construction and operation of additional natural gas facilities on the Big Inch lines by permitting the transmission company, pending further orders in the proceeding, to deliver and sell to East Ohio Gas Company, New York State Natural Gas Corporation, and Peoples Natural Gas Company (the Consolidated Companies) any quantities of natural gas that may be available in excess of 433,000,000 cu ft a day.

At the same time the Commission allowed Texas Eastern's proposed supplemental rate schedule, which provides for a change of service by increasing sales and deliveries to the Consolidated Companies, to take effect.

The Commission's order, however, specifies that no sales or deliveries shall be made by Texas Eastern to the Consolidated Companies until the corporation's daily sustained deliveries exceed 433,000,000 cu ft, the amount that it was authorized to deliver in the commission's opinion and order of October 10, 1947.

Texas Eastern's proposed construction, which received temporary FPC authorization May 28, 1948, would increase delivery capacity of the corporation's lines by 75,000,000 cu ft a day.

Gas Proposal Approved

Upon consideration of exceptions filed by New York State Natural Gas Corporation to a presiding examiner's decision authorizing the company to acquire, construct, and operate natural gas transmission facilities in Pennsylvania and New York, the Federal Power Commission has affirmed the examiner's decision with only a modification of the portion relating to recording of the acquisition.

Facilities authorized include acquisition from Empire Gas and Fuel Company of approximately 10 miles of 8 and 10-in. pipe line in Potter County, Pennsylvania; construction of a new measuring station and appurtenant facilities in Potter County for the delivery and sale of natural gas to Empire from the northern terminus of the line to be acquired; and construction and operation of two measuring stations, together with necessary connections, in New York to supply additional quantities of natural gas to Empire Gas and Fuel Company, Ltd. of New York.

Gas Facilities Authorized

The Federal Power Commission has authorized Tennessee Gas Transmission Company to construct and operate eight sales meter stations along its main transmission pipe line in northern Mississippi for sale and delivery of natural gas to United Gas Pipe Line Company of Shreveport, Louisiana. The Commission at the same time authorized the United Company to build and operate facilities for delivery and resale of the gas to United Gas Corporation, an affiliate.

The United affiliate proposes to distribute an estimated maximum of 8,766,000 cu ft of gas daily to fifteen Mississippi communities, none of which now have natural gas service.

FPC said the proposed contract between Tennessee Gas and the United Company "may be discriminatory" since it is the only maximum demand contract Tennessee has made under its field Rate Schedule G-3. All others under this schedule are full requirement contracts, the Commission added.

WITH THE Pipe Line Contractors

Smith Contracting Corporation, Fort Worth, Texas, began construction the middle of this month on 157 miles of 22-in. line for Shell Pipe Line Corporation from the Verdigris River in Rogers County, Oklahoma, to Buffalo, Missouri. This is a part of the Ozark Pipe Line System. F. A. Smith is general superintendent; Fred Peters spread superintendent of Section 3; Ivan E. Steele office manager of Section 3; Mirl Rumsey spread superintendent of Section 2, and Ben L. Mapes office manager of Section 2. Warehouses are at Vinita, Oklahoma, and Neosho, Missouri.

The early part of the month the company began work on 32½ miles of 12-in. for Shell from Wasson station to Hobbs station. J. H. Smith is the superintendent and E. A. Bell office manager. On the 80 miles of 10 and 12-in. from Wasson station to Wheeler station for Stanolind Pipe Line Company, about 70 miles had been completed to November 26. Bell is also superintendent of this job.

On the 170 miles of 24-in. being laid from Wichita Falls, Texas, to Cushing, Oklahoma for The Texas Pipe Line Company, 70 miles had been completed on November 26. C. C. Craig is superintendent and H. G. Brekenridge office manager.

Sheehan Pipe Line Construction Company, Tulsa, Oklahoma, expects to have completed by January 1 the 110-mile, 12-in. line it is laying for Buckeye Pipe Line Company from Cygnet to Cleveland, Ohio. Six miles of 12-in. was completed December 1 near East St. Louis, Illinois, for Magnolia Pipe Line Company.

This contractor also is laying 63 miles of 12-in. for Stanolind Pipe Line Company from La Plata, Missouri, to Wood River, Illinois. One crew is working out of Shelbina, Missouri, and one out of St. Charles, Missouri.

Latex Construction Company, Houston, Texas, reports that on the 70 miles of 24-in. loop lines being laid for Southern Natural Gas Company in Eastern Alabama and Georgia, the job is complete except for Coosa River crossing, which has been delayed by pipe arrival and floods. W. H. Hayes is superintendent; M. L. Thompson, assistant superintendent; A. E. Stremmel and John Strickler, office. Present headquarters are at Anniston, Alabama.

The 250 miles of 6-in., 8-in., and 10-in. take-up and yard reconditioning for The Texas Pipe Line Company from Humble to Port Arthur, Texas, has approximately 125 miles completed (November 30). H. L. Leake is in charge of take-up; Sam Harrison, office; H. E. Murphy, in charge of rack; E. L. Peterson, office. Present headquarters are at Liberty, Texas.

Construction of tank farm piping, pump station, and manifolds for The Texas Pipe Line Company at West Columbia, Texas is 90 per cent completed. J. B. Latham is superintendent; W. E. Bayles, office. Present headquarters are West Columbia, Texas.

On the 65 miles of 12-in. take-up, reconditioning, and re-lay for the Houston Pipe Line Company, take-up is completed. Approximately 40 miles have been completed on the re-lay. J. A. Cantrell's spread is working out of Sour Lake and E. C. Norris' spread out of Liberty. Both are on re-lay. J. A. Williamson is putting in the San Jacinto River crossing.

A 24-mile 8-in. products line is being laid for Alamo Refining Company from Sweeny to Freeport, Texas. This job is just starting. F. A. Silar is superintendent. C. V. Oliver is in charge of the office. Present headquarters are at West Columbia, Texas.

Vaughn & Taylor Construction Company, Inc., Wichita Falls, Texas, had completed approximately 50 per cent (November 23) of the 90-mile gathering system being constructed for Phillips Petroleum Company to serve its Hansford plant near Texoma, Oklahoma. Diameter of the pipe ranges from 8 in. to 24 in. D. D. Vaughn is the superintendent.

Trojan Construction Company, Inc., Oklahoma City, Oklahoma, began work December 1 on a crude oil gathering system in the West Cement Medrano pool, Oklahoma, for Phillips Pipe Line Company. This job consists of 32,700 ft of 4½-in. pipe and 2500 ft of 6⅝-in. Maurice Crawford is superintendent and Bill Skinner is in charge of the office.

Work also has begun on salvaging an 8-in. line across the Arkansas River near Camp Gruber for Oklahoma Natural Gas Company. Swede Tillotson is the superintendent.

Crews in charge of Tillotson completed during November a 70-mile, 16-in. line from Holdenville to Maysville, Oklahoma, and 10 miles of 18-in. in the vicinity of Muskogee, Oklahoma, for Oklahoma Natural Gas Company.

A crew under the superintendency of Maurice Crawford laid 14,000 ft of 10-in. between Maysville and Velma, Oklahoma, for Oklahoma Natural. Another job for this company, 35 miles of 12-in. between Maysville and Velma, has been shut down for lack of pipe. At the time 25 miles had been finished.

Tulsa Pipe Coating Company, Tulsa, Oklahoma, has several jobs under way for Oklahoma Natural Gas Company. Between Maysville and Holdenville 65 miles of 16-in. pipe is being coated, with 95 per cent completed November 30. W. F. Secrest is foreman. Between Maysville and Chickasha 35 miles of 12-in. is being coated, this job also being 95 per cent completed. D. S. Sullivan is foreman. The 35 miles of 12-in. between Maysville and Duncan was 80 per cent completed the first of the month, with Sam Bowen in charge. Between Maysville and Haskell 8 miles of 18-in. was 95 per cent completed November 30. Secrest also was foreman on this job.

The company began coating 6 miles of 6-in. at Cement, Oklahoma, on November 30 for Standish Pipeline Company. Sam Bowen is in charge. Bowen also will supervise the coating of 3 miles of 12-in. at Wellston, Oklahoma, for Oklahoma Natural, which will start December 30.

Somerville Construction Company, Ada, Michigan, is doing a 40-mile takeup job for Sohio Oil Company in Illinois, Indiana, and Kentucky, of 2-in. to 6-in. pipe. Five miles had been completed to November 23. C. G. Daniel is superintendent. A brine disposal system is being laid of transite pipe in the Kimball Lake field, Michigan, for Sun Oil Company. The superintendent is Pat Mask.

Wilson Construction Company, Tulsa, Oklahoma, has completed two jobs in Lincoln, Nebraska. An 8½-mile, 6-in. line was laid for the City of Lincoln from its meter station to the Army Air Base. A 6½-mile, 6-in. line was laid for Central Gas and Electric Company from an emergency plant to the air base.

Wilson also is doing a 10-mile takeup and re-lay job for Panhandle Eastern Pipe Line Company in the Hugoton gas field. M. L. Mathews, Jr., is the general superintendent and B. A. Alley manager of the field office.

The Fish Engineering Corporation, Houston, Texas, has been given a manager constructor's contract by Trans-Continental Gas Pipe Line Corporation to construct 2250 miles of pipe line and ten compressor stations on a system that will extend from the lower Rio Grande Valley of Texas to New York City. There will be 1839 miles of main line and in excess of 400 miles of laterals. The main line will consist of 20-in., 26-in., and 30-in. pipe. Initially 72,000 compressor hp will be installed. This will give a line capacity of 340,000,000 cu ft a day. For complete story see page 243 of this issue of *The Petroleum Engineeer.*

H. C. Price Company, Pipe Line Division, announces progress on jobs as follows:

Southern Natural Gas Company. Awarded a general contract covering construction of 35 miles of 24-in. pipe line loop near Birmingham, Alabama; 99 per cent complete on December 1. Field office in Bessemer, Alabama. W. B. Williams is superintendent. Foremen include: R. H. Edwards and D. L. Beachy, right-of-way; K. K. Kelly, ditch; Roy Stegall, bend: J. I. Cobb, pipe; C. F. Jones, weld; Rube Owens, coat: A. D. Hamilton, lower-in, and Fred Williams, clean-up.

Tennessee Gas Transmission Company. Awarded general contract covering construction of 30-31-in. high pressure natural gas pipe line loops. Section A loop, 79 miles extending northeast of El Campo, Texas, and Section C loop extending 55 miles northeast of Many, Louisiana, to a point near Natchitoches, Louisiana. Completed on November 7.

The Somastic Division announces the following:

Buckeye Pipe Line Company. The application of Somastic coating to approximately 82 miles of 22-in. O D pipe, which will be laid from Lima to Toledo, Ohio. Somastic plant is at Findlay, Ohio. Phone 3971. Elwood Roth is superintendent; J. C. Caldwell, office manager. Foremen: Jack Raney, Bill Atkins, and Walter Gabbard. Plant inspectors: D. B. Van Campen and L. W. Versoy.

Socony-Vacuum Oil Company, Inc. Contracted application of Somastic coating to 125 miles of 6⅝-in. O D pipe for a products line to be laid from Portland to Bangor, via Augusta, all in Maine. Plant coating completed. Mailing address: DeWitt Hotel, Lewiston, Maine. H. A. Jacobs, field superintendent; J. G. Umbarger, office manager. Foremen: R. L. Young and F. O. Griffith.

Also the application of coating to approximately 154 miles of 8⅝-in. O D pipe for a products pipe line laid from Malvern, Pennsylvania, to Binghamton, New York. Mailing address: Taylor, Pennsylvania, Phone, Scranton 42277. Hugh Clements, superintendent; M. Anderson, office manager. Foremen: Leo F. Grannell, V. J. Jones, M. Jack Lane, and E. E. Dyess. Inspector: C. Weidenmeyer.

Stanolind Oil and Gas Company. Order received October 6, 1948 for application of Somastic coating to 6500 linear ft of 30-in. pipe in connection with Stanolind's gathering and residue system near Sundown, Texas, which was Somastic coated during the current year. Mailing address: P. O. Box 583, Sundown, Texas. Phone, 115. William Bauer, superintendent; Henry Wade, foreman.

Socony-Vacuum Oil Company, Inc. Contracted application of coating to approximately 35 miles of 6⅝-in. O D pipe, which will connect with the Pennsylvania to New York line and feed various distribution points along the line. Mailing address: Tavlor, Pennsylvania. Phone Scranton 42277. Hugh Clement, project superintendent; M. Anderson, office manager.

Anderson Brothers Corporation, Houston, Texas, has been awarded a contract by the Shell Pipe Line Corporation to lay a part of the Ozark Pipe Line System, which extends from Cushing, Oklahoma, to Wood River, Illinois. The part contracted to Anderson Brothers was Sections 4, 5. and 6, 201 miles of 22-in. from Roxdale station to Wood River, including a single river crossing of the Gasconade River and dual crossings of the Missouri and Mississippi rivers.

J. R. Horrigan Construction Company, Inc., Houston, Texas, advises that Gang No. 2 is working out of Manhattan, Kansas, after a shutdown due to lack of pipe. This is on an 80-mile section of the 470 miles being laid for Michigan-Wisconsin Pipe Line Company. Gang No. 1 has completed its 270-mile section and Gang No. 3 its 104-mile section.

The 32 miles of 26-in. laid near Memphis, Tennessee, for Texas Gas Transmission Corporation, has been completed.

Williams Brothers Corporation, Tulsa, Oklahoma, expects to complete the latter part of February the 155-mile, 24-26-in. crude oil line being laid for Creole Petroleum Corporation from Ule tank farm to La Salina-Amuay Bay, Paraguana, Venezuela. About the same date it is expected that the 6-in., 255-mile oil line being constructed for Yacimientos Petroliferos Fiscales Bolivianos from Camiri to Cochabamba to Sucre will be completed.

Nearing completion is the 150-mile, 20-in. gas line from Poza Rica to Mexico City, being laid for Petroleos Mexicanos. The contractor has moved his crew into Mexico City for completion of this work.

Williams Brothers also have underway 47 miles of 10-in. for The Texas Empire Pipe Line Company between Cushing and Tulsa, Oklahoma. T. E. Davis is superintendent of this project and John Purdy office manager. Field headquarters are at Drumright.

Ray L. Smith and Son, Inc., Eldorado, Kansas, has completed Cities Service Gas Company's 26-in. line from Ulysses, Kansas (in the Hugoton field) to Hutchinson, Kansas. A feature article on this project begins on page 245 of this issue of *The Petroleum Engineer.* William G. Frost was in charge of construction.

This contractor also has in progress the takeup of 45 miles of 16-in. pipe for Cities Service at Oswego, Kansas.

L. E. Farley, Inc., Houston, Texas, recently laid 1¼ miles of 18-in. and 24-in. pipe for United Gas Pipe Line Company in Jefferson and Orleans parishes, Louisiana. G. L. Allman was sueprintendent and F. L. Hudson office manager.

McVean & Roberts, Odessa, Texas, began the laying of 11 miles of 4, 6, and 8-in. pipe November 15 for Stanolind Pipe Line Company near Andrews, Texas. A 7½-mile reconditioning job being done for Shell Pipe Line Corporation from Wink to McCamey, Texas, was a third completed November 20. This pipe is 6 and 10-in. diam.

Eastern Construction Company, Dallas, Texas, reports work at a virtual standstill on the Lone Star Gas Company line from Opelika to a point on the company's system between Dallas and Garland, Texas. Inability to obtain line pipe is slowing down work. This is a 70-mile, 20-in. line of which about eight miles have been laid. F. K. Brown is superintendent for the contractor and Frank Hindman is in charge of field office.

Midwestern Constructors, Inc., Tulsa, Oklahoma, has been awarded the laying of 77 miles of 22-in. pipe on the Ozark System by Shell Pipe Line Corporation, from Cushing, Oklahoma, to the Verdigris River, including dual crossings of the Cimarron and Arkansas rivers. M. T. Wilhite is the superintendent in charge.

This contractor has completed the laying of 155 miles of 8-in. from Malvern, Pennsylvania, to Binghamton, New York, for Socony-Vacuum Oil Company, Inc. Two spreads were worked on the job with Lacy Walker and Richard Leonard, the superintendents.

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MAINTENANCE COSTS?

That is the problem . . . here is the solution . . .

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Production and Drilling	*Drill Stem*—Drill mud under high pressure. Corrosion caused by salt water. Stress corrosion cracking. Tubing, casing, sucker rods—Corrosion caused by hydrogen sulfide, salt water and sour crude. Equipment subject to electrolysis. Paraffin and gyp scale build-up in tubing.	AMERCOAT Tube and Tank Lining is abrasion resistant and is unaffected by electrolytic corrosion since it is a non-conductor. It has excellent adhesion and reduces friction loss in pipe. AMERCOAT is unaffected by salt water and hydrogen sulfide. AMERCOAT Tube and Tank Lining provides a dense, smooth surface and prevents corrosion caused by salt water and sour crude. It is unaffected by electrolytic action under gyp scale and its smooth, oil-impervious surface greatly reduces the build-up of paraffin in tubing. Reports show that AMERCOAT increased the life of well tubing over six times.
Transportation	*Tank Cars, Tank Trucks, Shipping Containers. Interior*—surfaces are subject to corrosion caused by petroleum products. In equipment used for transporting aviation gasoline, contamination is a factor. *Exterior*—These surfaces are subject to spillage of petroleum products and weathering.	*Interior*—No. 23 is recommended since it protects steel surfaces against corrosion caused by petroleum products. No. 23 is non-contaminating to petroleum products and offers ideal protection for aviation gasoline. *Exterior*—No. 33 is unaffected by the splash and spillage of petroleum products and resists the corrosive effects of weathering.

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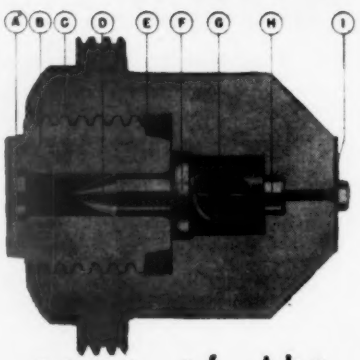
Penetration



Here are some of the reasons

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(B) BARREL. Uniform precision of milled barrel and chamber threads permits interchangeability of barrels of varying calibres.

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(H) CONTACT PIN ASSEMBLY. Conveys direct current from wired gun port to filament. Washer and insulation eliminate loss of powder gas through back of chamber.

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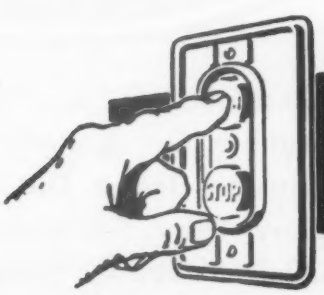

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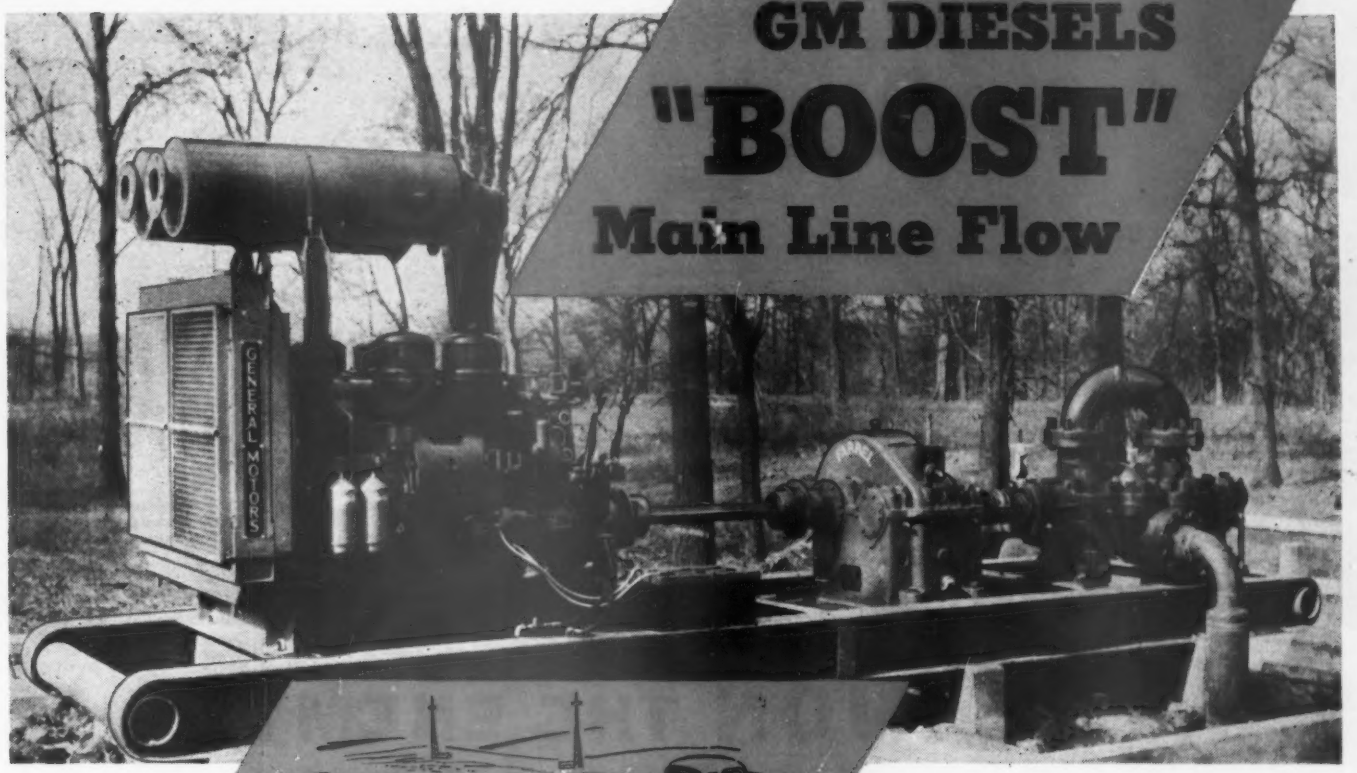

Portable pumping unit designed around a General Motors Series 71 "Twin" by the Diesel Power Company of Oklahoma City for Phillips Petroleum Company

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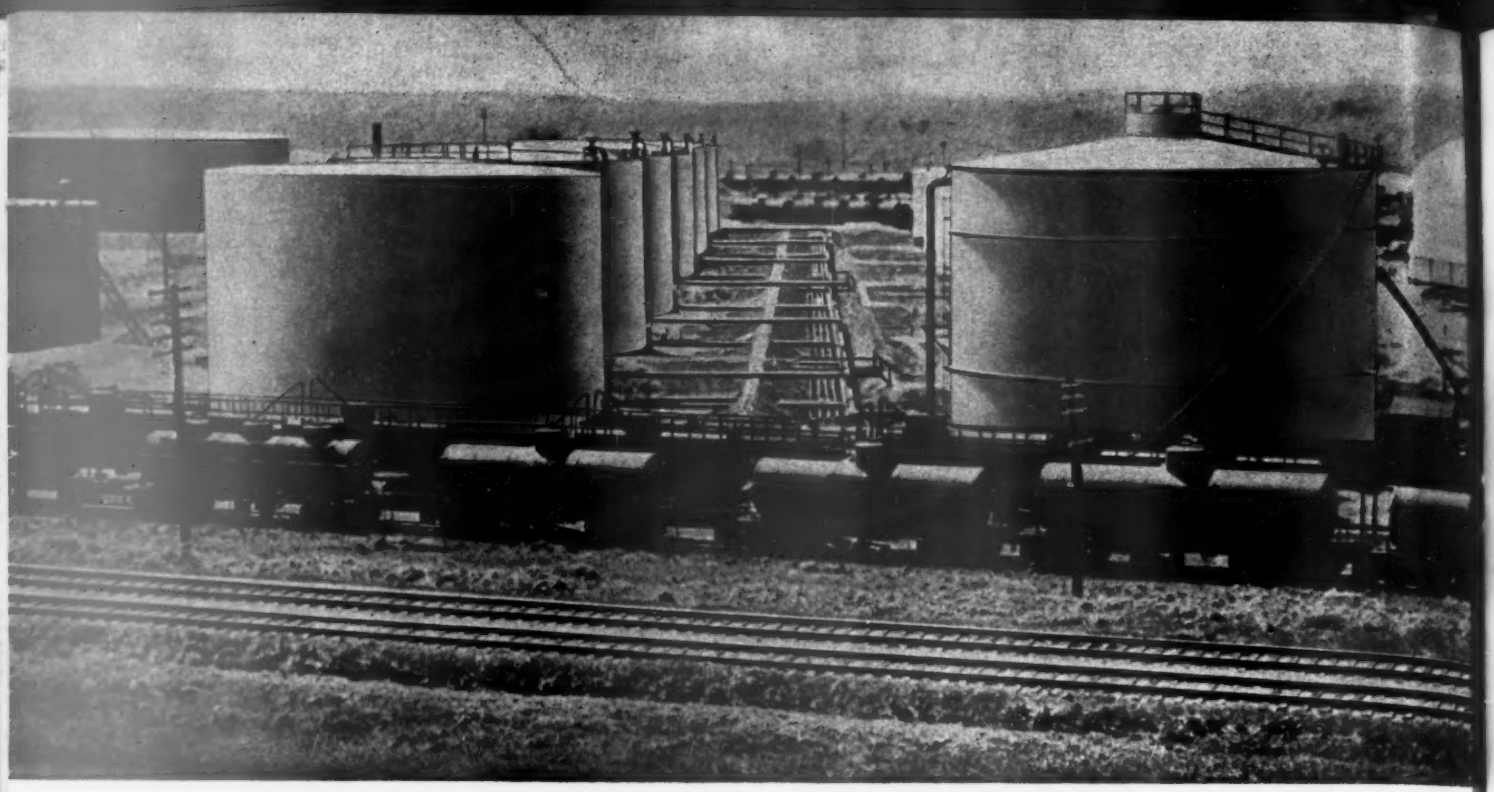

EVAPORATION THE ENEMY OF CONSERVATION

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- Balloon Roofs
- Breather Roofs
- Dry Seal Lifter Roofs
- Dry Seal Gasholders

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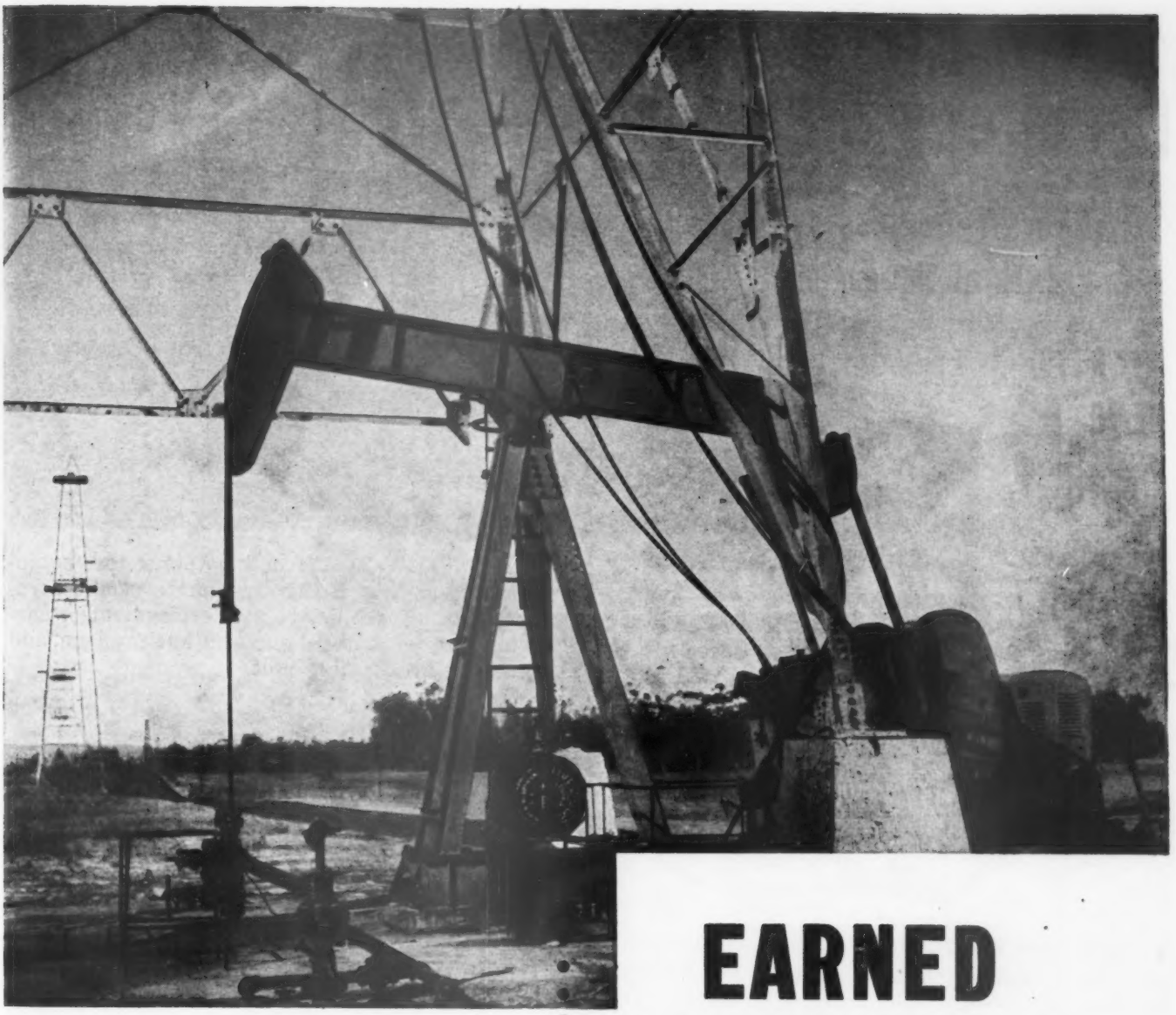

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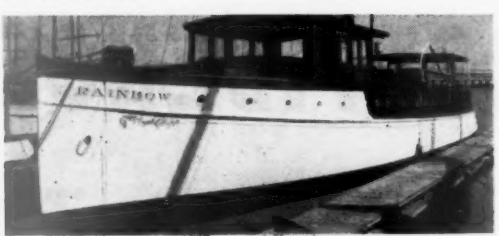
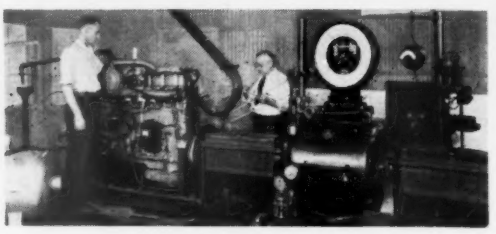
2—EARLY CARBURETORS incorporating patented Ensign principles were used on tractors, automobiles and trucks.



3—HEAVY FUEL CARBURETORS with spark ignited vaporizing chamber were popular on tractors and marine installations.

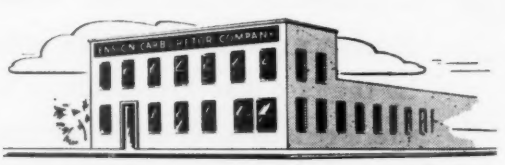
4—IN 1914 O. H. Ensign with his vigorous little company of technicians moved to new large quarters. Many domestic and foreign sales outlets were established. The majority of tractor builders adopted Ensign as standard equipment.

In oil fields the world over the name ENSIGN is synonymous with dependability and service.



5—ONLY THE FINEST of laboratory test equipment is used at Ensign's. Many special instruments and machines to aid development of carburetors for natural gas, butane-propane and gasoline are Ensign built.

6—WITH YEARS OF SERVICE to the oil, agricultural and transportation industries the company's continued growth called for additional plant facilities. Today, in its present modern factory employing several hundred persons, every operation from foundry to final testing is completed.



7—THE ENSIGN BRANCH FACTORY at Chicago has for many years offered eastern engine builders prompt and efficient service. Ensign factory engineers and distributors in all active areas are constantly in search of better methods and for opportunities to serve.

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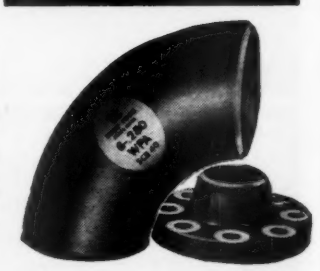

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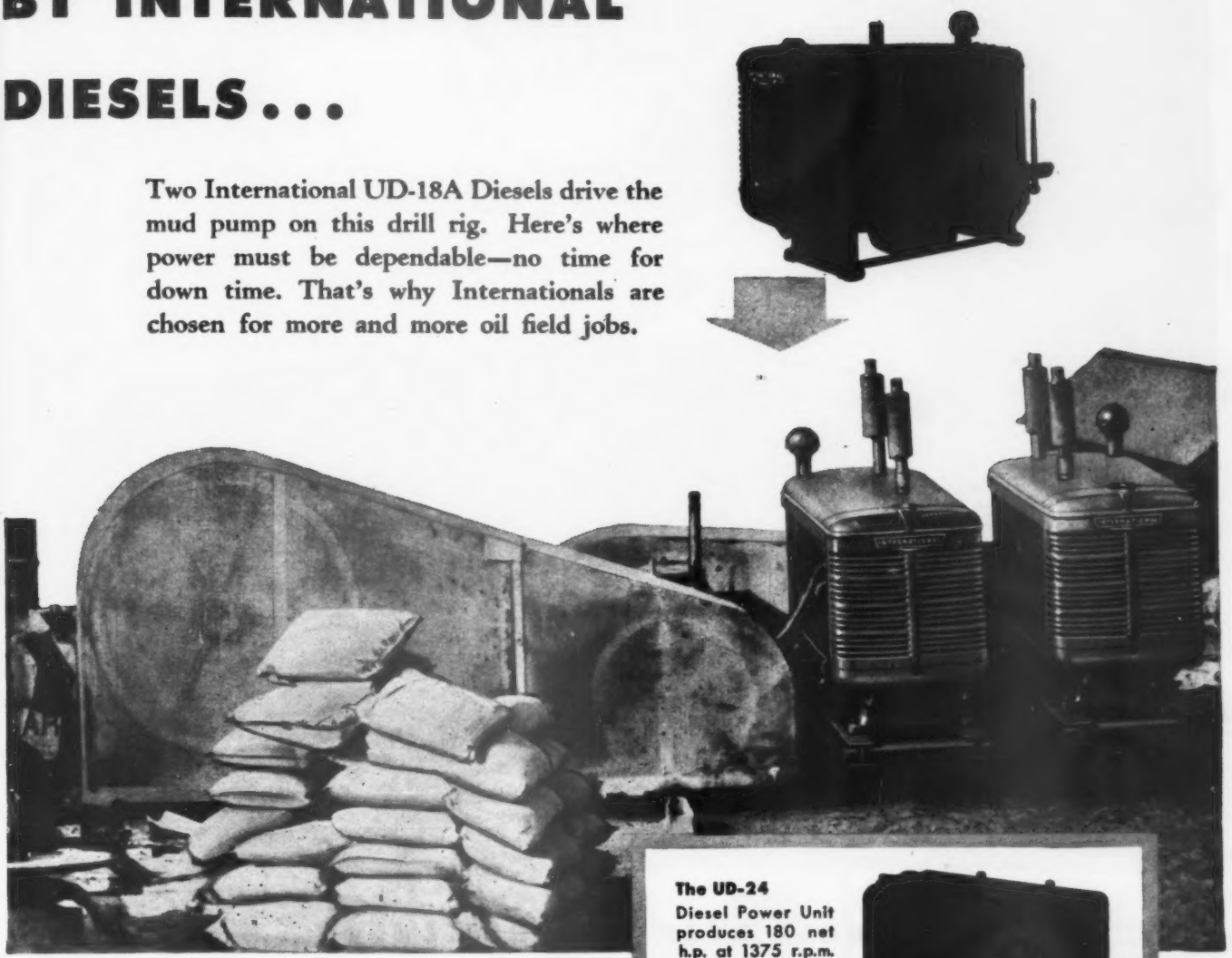

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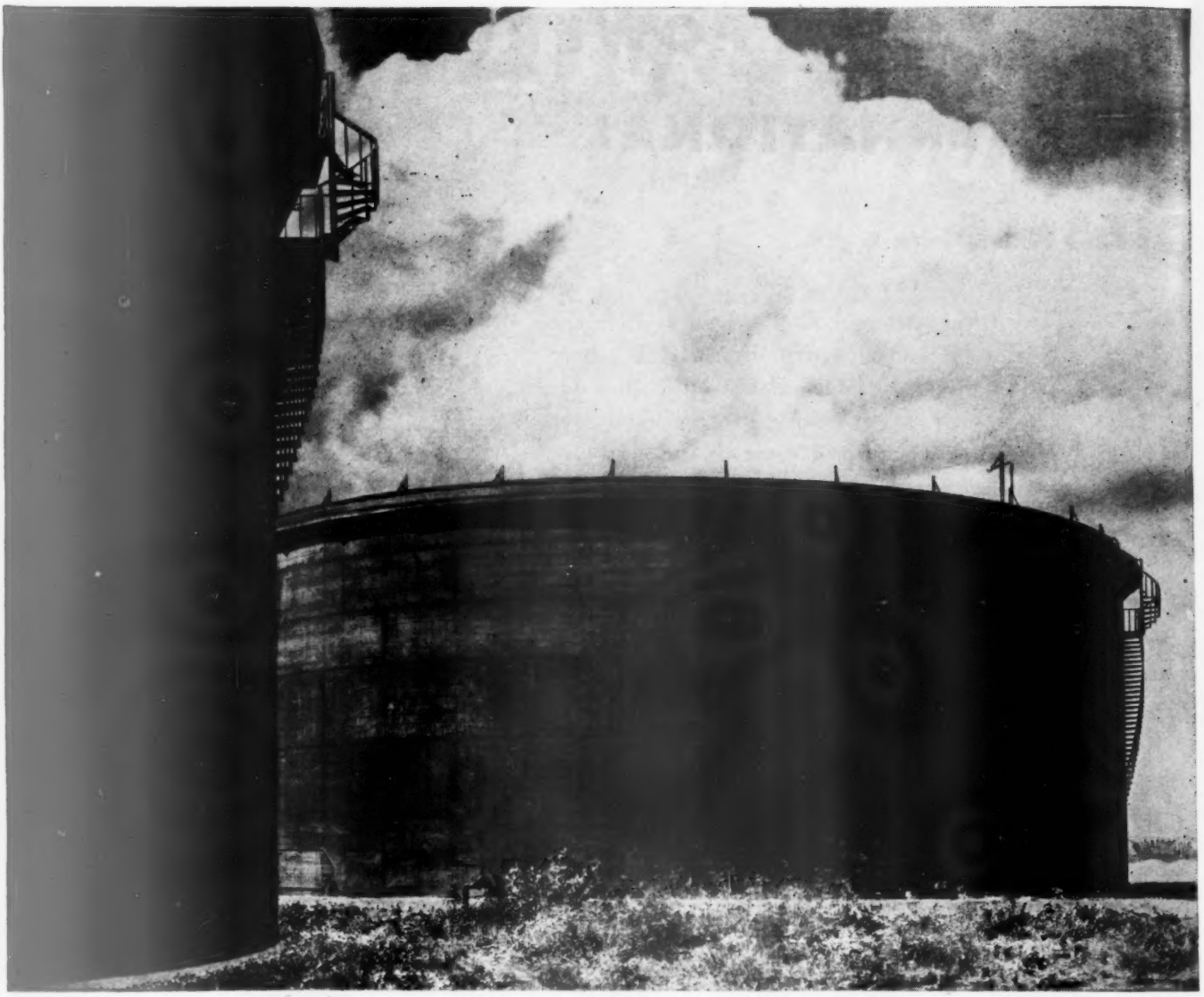

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If filling losses far exceed standing losses in your storage installation, the Graver Improved Floating Roof *with full double deck* is your best protection. It's designed to prevent all the filling losses *plus* as high as fifty percent of the standing losses . . . the greatest possible overall saving for such set-ups as a deep water terminal.

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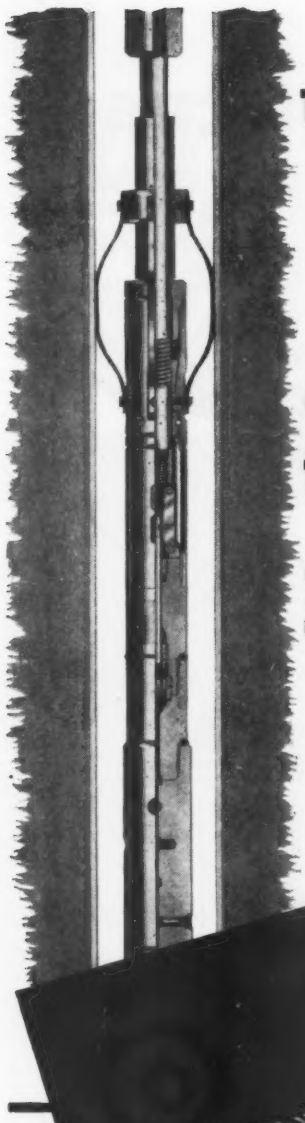

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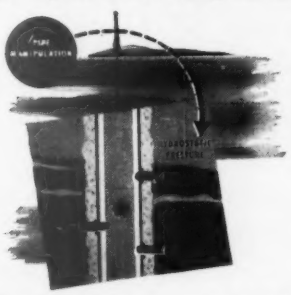
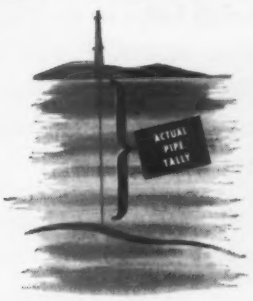
Combines 5 Outstanding Features for better gun perforating operation!

By selecting a Johnston Gun Perforator you get years-ahead Gun Perforator design for an easier, more economical method of perforating casing. In addition, this Gun Perforator serves as the perforating unit in *combined* "Shoot-n-Test" operations for the slickest possible way of obtaining water shut-off information, doing exploratory work or testing for actual production.



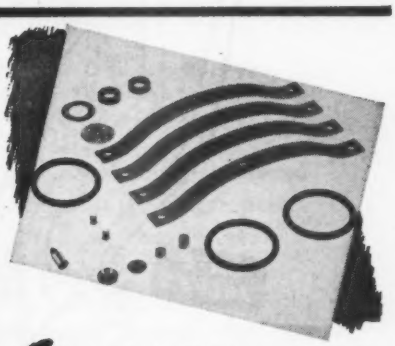
1 Safer Operating . . . because the Johnston Gun Perforator fires only when subjected to *both* in-the-hole hydrostatic pressure and definite top-hole pipe manipulation. You get safety in transporting and rig-floor handling and positive protection against premature firing on the run-in.



2 More Exact Positioning . . . because the Johnston Gun Perforator is tallied in on your own tubing or drill string – no guess work, no elaborate measuring devices . . . you connect the Gun Perforator on the bottom joint of pipe and run-in until actual pipe-in-the-hole tally spots unit opposite the formation to be perforated.

3 Simultaneous Fire of ALL Projectiles . . . because of the hydrostatic firing principle of the firing head and flash hole design of each perforating gun section, the firing of all chambers is virtually instantaneous and all projectiles are projected simultaneously . . . an important feature because *balanced* recoil increases penetration depth and assures proper spacing of perforations.

4 Field Car Portability . . . because the firing head, together with the number of perforating gun body sections selected for any particular perforating job can be easily transported in the back of a regular pick-up truck or field car. *After* arriving at the well location, the Gun Perforator can be assembled with standard hand tools.



5 Faster, Easier Maintenance . . . because of the minimum number of working parts in the firing head and the *few* expendable supplies required after each job. All expended supplies are easily replaced during normal reassembly after cleaning and drying the firing head and perforating gun sections.

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Take a Catalyst Storage Hopper, for example. Crane supplies all valves, fittings, accessories, fabricated piping or pipe, for this as well as for any other refinery installation. One catalog gives you the world's most complete selection of brass, iron, steel and alloy piping materials . . . all designed to meet rigid refinery specifications.

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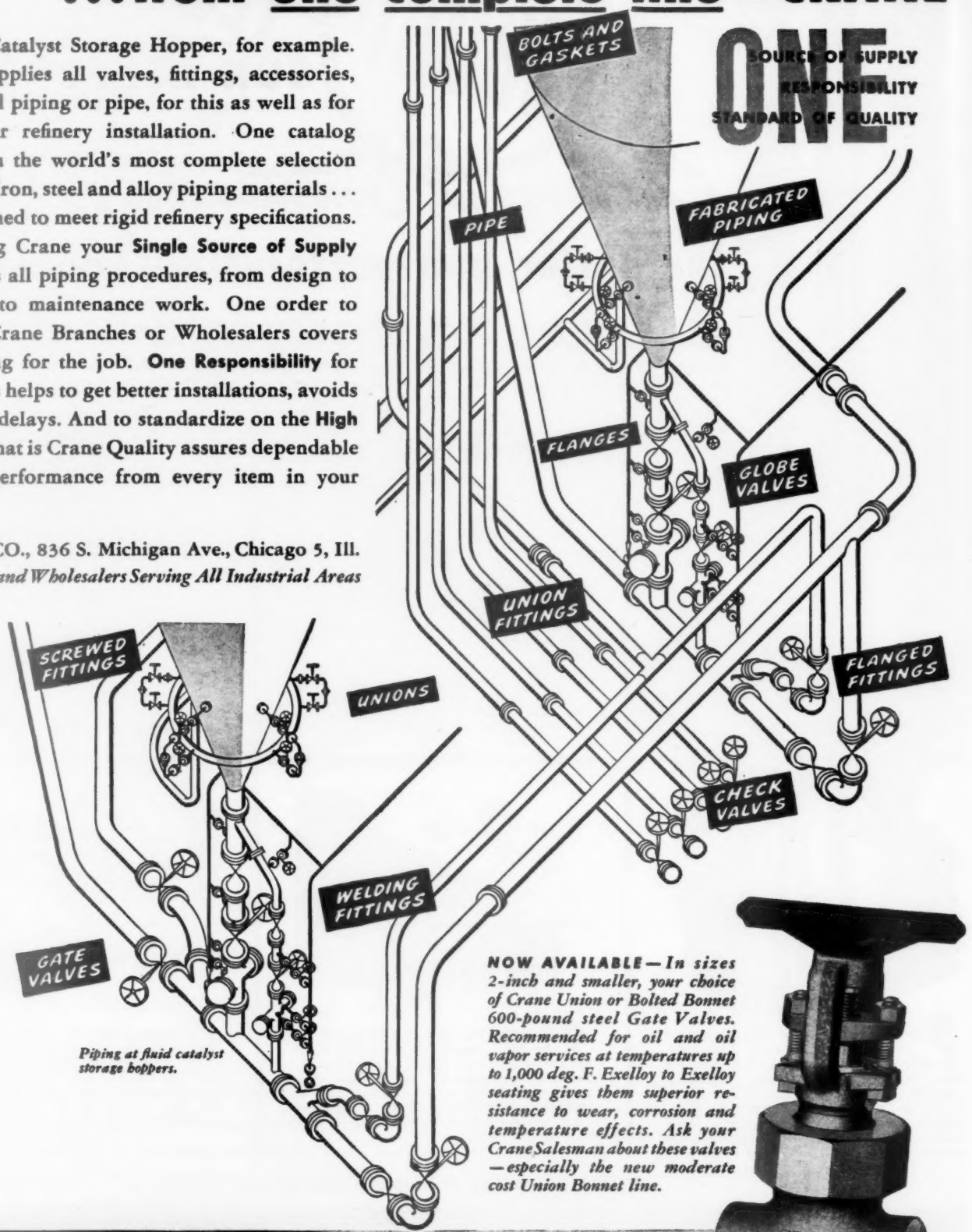

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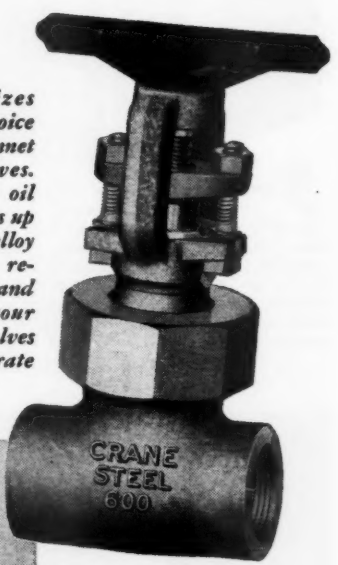
NOW AVAILABLE—*In sizes 2-inch and smaller, your choice of Crane Union or Bolted Bonnet 600-pound steel Gate Valves. Recommended for oil and oil vapor services at temperatures up to 1,000 deg. F. Exelloy to Exelloy seating gives them superior resistance to wear, corrosion and temperature effects. Ask your Crane Salesman about these valves —especially the new moderate cost Union Bonnet line.*



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FOR EVERY PIPING SYSTEM

Twin Disc Clutches *on this job, too!*

Twin Disc Model CL Clutch.

There are four Twin Disc Model CL Clutches in the Winter-Weiss Portadrill transfer case. The Portadrill is used mainly for exploratory drilling and shallow oil production.

Exploratory drilling calls for speed . . . portable rigs that must move fast and drill fast.

Fast drilling demands a fast-acting clutch . . . like Twin Disc's Model CL. The CL is a heavy-duty friction clutch, yet small and compact . . . designed for high-speed installations demanding easy engagement and disengagement.

Overall dimensions are held to a minimum to conserve space. Action parts are hardened and ground. Wide friction surfaces are used. High grade molded asbestos friction material and highly finished surfaces on the clutch plates reduce wear to a minimum and assure smooth positive operation.

Twin Disc Model CL Clutches are available in one, two and three plate models, 5.5″ to 11.5″, with working capacities ranging from 12 to 125 hp. For complete information, write for Bulletin 120-C. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

Hydraulic Torque Converter

Heavy Duty Clutch

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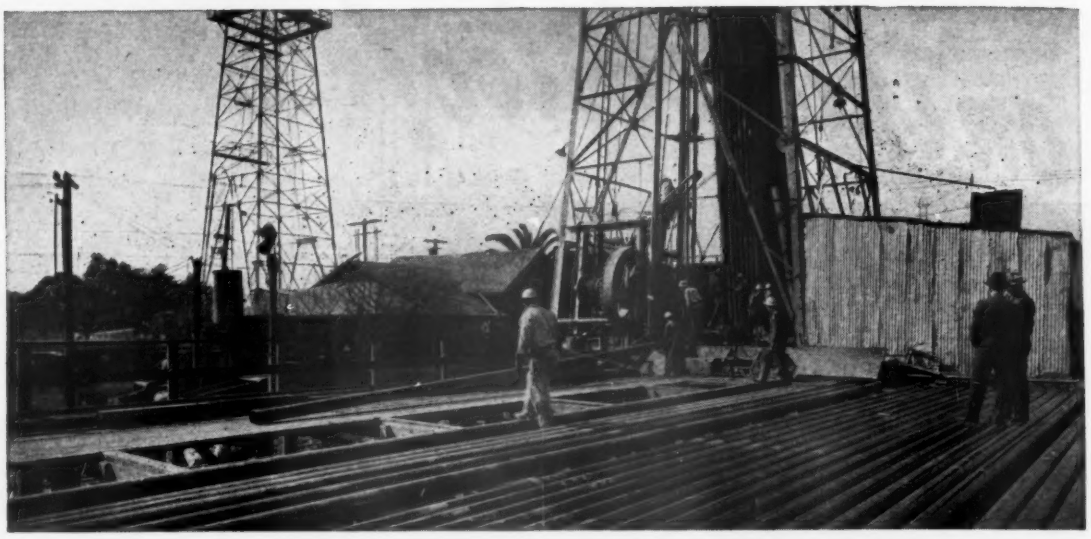
TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

DEPENDABILITY THROUGH



IN A CALIFORNIA FIELD: Running seven-inch S-80 SMITHway Casing.

RESEARCH AND ENGINEERING

IN THE A. O. SMITH MILL: Hydrostatic-testing S-80 SMITHway Casing.

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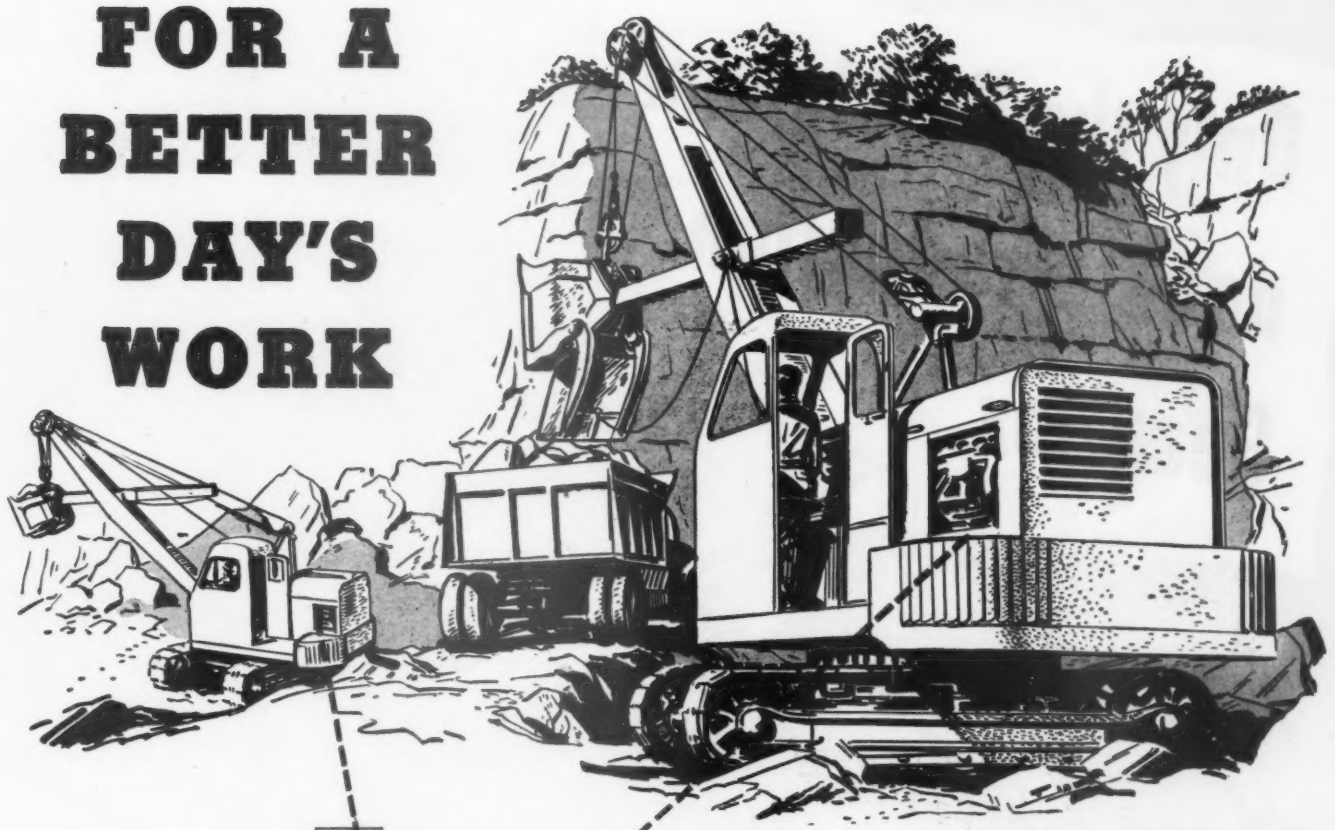
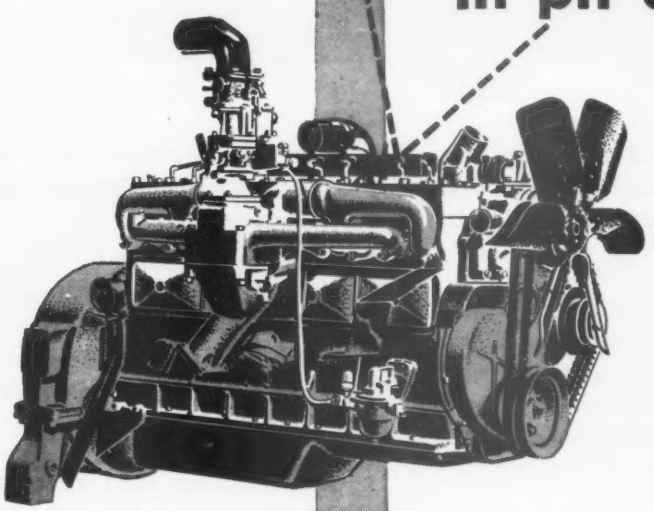


in pit and quarry operations



● **Where digging is tough and tricky . . . where steady, dependable power is the difference between profit and loss . . . you'll find Chrysler Industrial Engines and Power Units on the job! Chrysler Industrial Engines provide power *for a better day's work* on cranes, shovels, pumps, cableways, conveyors, drills, crushers and in other mining or quarrying equipment. For economical power that's tailored to *every* industrial application, see the Chrysler Industrial Engine dealer near you; for detailed data and specifications, write . . .**

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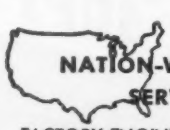

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CHRYSLER

INDUSTRIAL ENGINES AND POWER UNITS

HORSEPOWER WITH A PEDIGREE

Only the Bethlehem double-reduction Gear Box

has all these features

★ Rugged, high-strength cast case for rigidity. Unitary construction (no splits) for alignment.

★ Jumbo shafts, forged and heat-treated, for strength and minimum deflection.

★ 100% roller-bearing construction for top efficiency, lowest starting torque. Bearings designed for 100,000 hours B-10 life.

★ Settling chamber—catches foreign matter; separates water of condensation; conserves oil with its separate drain.

★ *All* forged-steel herringbone gears of generous diameter and face. Strong, smooth, quiet in operation.

★ Circulating flood lubrication; no oil seals to leak or replace. Clean oil flows continuously *through* every bearing. System works at low speeds and with either direction of rotation.

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★ Double pinion-shaft extension; prime mover can be put either side.

★ Interchangeability—four for one. Each double-reduction gear interchanges with:

Single-reduction box of same A.P.I. size Double-reduction box of next A.P.I. size Single-reduction box of next A.P.I. size	All on same structural assembly

★ All ratings are A.P.I. sizes and exceed minimum A.P.I. capacity.

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Subsidiary of Bethlehem Steel Corporation

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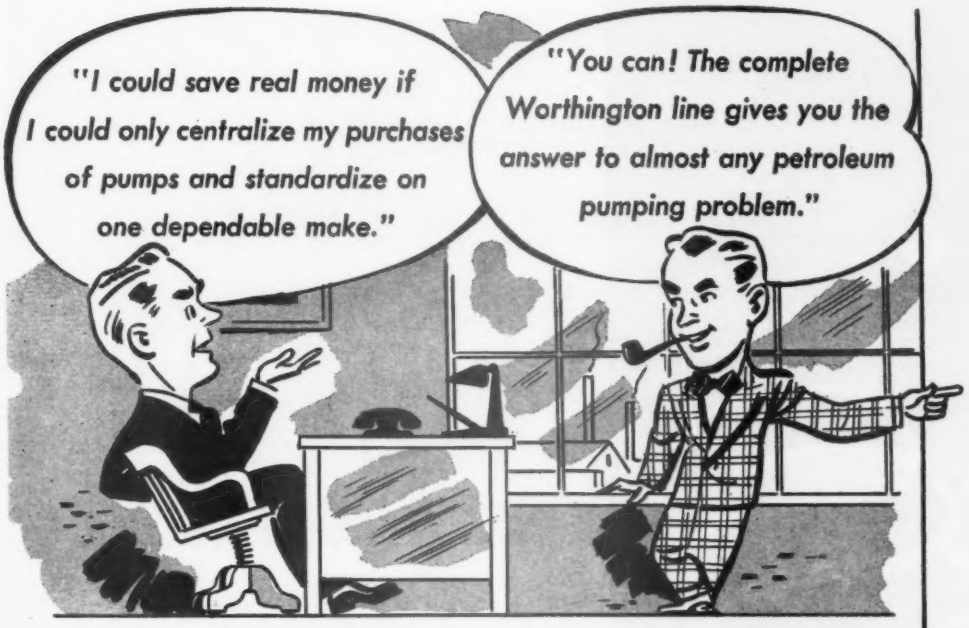
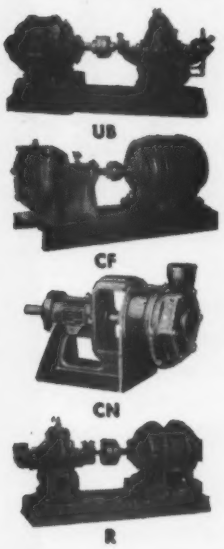
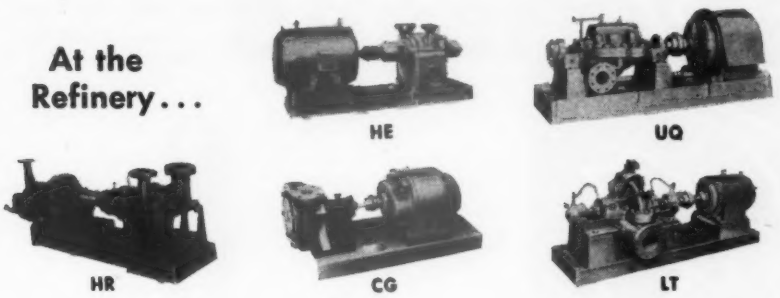

"I could save real money if I could only centralize my purchases of pumps and standardize on one dependable make."
"You can! The complete Worthington line gives you the answer to almost any petroleum pumping problem."

In The Field . . .

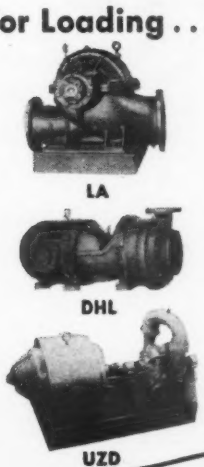


At the Refinery . . .



On The Pipe Line . . .

For Loading . . .



THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

LET WORTHINGTON WORK WITH YOU

Yes, WORTHINGTON . . . the world's largest manufacturer of pumps . . . offers you complete service in petroleum pumps for applications in the field, in the refinery, on the pipe line and for loading operations. Why not take advantage of WORTHINGTON's long experience in petroleum pumping problems to lower your cost by standardizing on this single, dependable source?

For complete information on any specific pumping application that will prove *there's more worth in Worthington,* write: *Worthington Pump and Machinery Corporation, Centrifugal Pump Div., Harrison, New Jersey.*

MEMBER

WORTHINGTON

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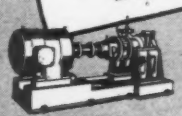
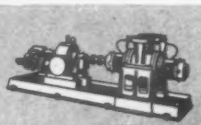
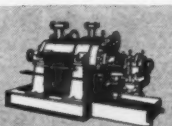


Types HR and HB. Twenty sizes. Capacities up to 1800 g.p.m. Developed heads up to 900 ft. Proper selection of material permits use for temperatures far below zero to 800°F., for pressures from high vacuum to 750 lb. per sq. in. gauge.



Type HD. Hydraulically-balanced, double-suction impeller handles boiling liquids with low submergence. Capacities range from 60 to 3200 g.p.m. at heads up to 700 ft., temperatures up to 850°F., pressures up to 550 lb.



Type WH. High-pressure, high-temperature, centrifugal hot-charge pumps. Twelve distinct points of superiority, based on years of experience building pumps for high pressures and temperatures. Capacities to 2000 g.p.m., heads to 5000 ft.

Type HL. Several construction arrangements permit flexibility in application. Designed for temperatures up to 225°F., or higher with water-jacketed stuffing box. Capacities up to 1600 g.p.m., heads to 500 ft.

Season's
Greetings
from the
REED ROLLER BIT COMPANY
HOUSTON, TEXAS

National IDEAL
POWER SLUSH PUMPS

WEAR-PROTECTED*
for long life and low-cost service

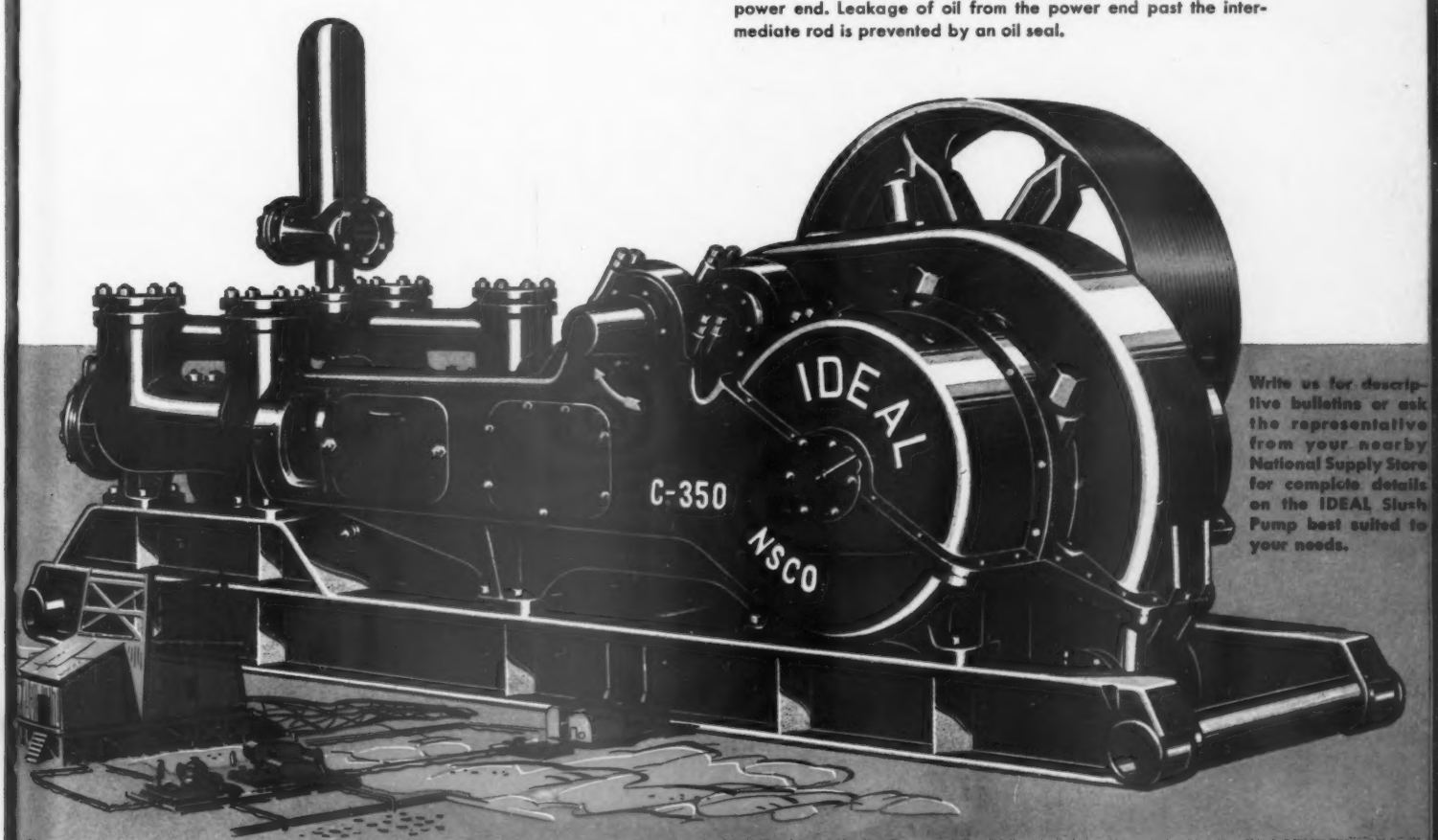
Because National IDEAL Power Slush Pumps are carefully protected at all wear points, they perform dependably and economically on tour after tour . . . delivering thousands of hours of heavy-duty service with minimum maintenance attention.

***Protected through Positive Lubrication**

Oil picked up by the main gear, which dips in the sump, is cascaded over the crossheads to provide lubrication for the crosshead bearings and guides, and is then returned to the sump. The crank and pinion shaft bearings are grease packed through connections easily accessible from outside the gear case to prevent infiltration of crankcase oil.

***Patented Protection from Contamination**

To prevent contamination of the crankcase oil, an intermediate wall is provided between the fluid end stuffing box and the power end oil seal. Only the fluid carried on the rod itself can get past this wall. A large baffle on the water piston rod lock nut prevents further travel of this fluid. Drilling fluid from a leaky stuffing box cannot be splashed on the intermediate rod and carried into the power end. Leakage of oil from the power end past the intermediate rod is prevented by an oil seal.



Write us for descriptive bulletins or ask the representative from your nearby National Supply Store for complete details on the IDEAL Slush Pump best suited to your needs.

THE NATIONAL SUPPLY COMPANY

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NATIONAL BLUE PRODUCTS

★ THE INDUSTRY'S MOST COMPLETE LINE OF OIL FIELD EQUIPMENT ★

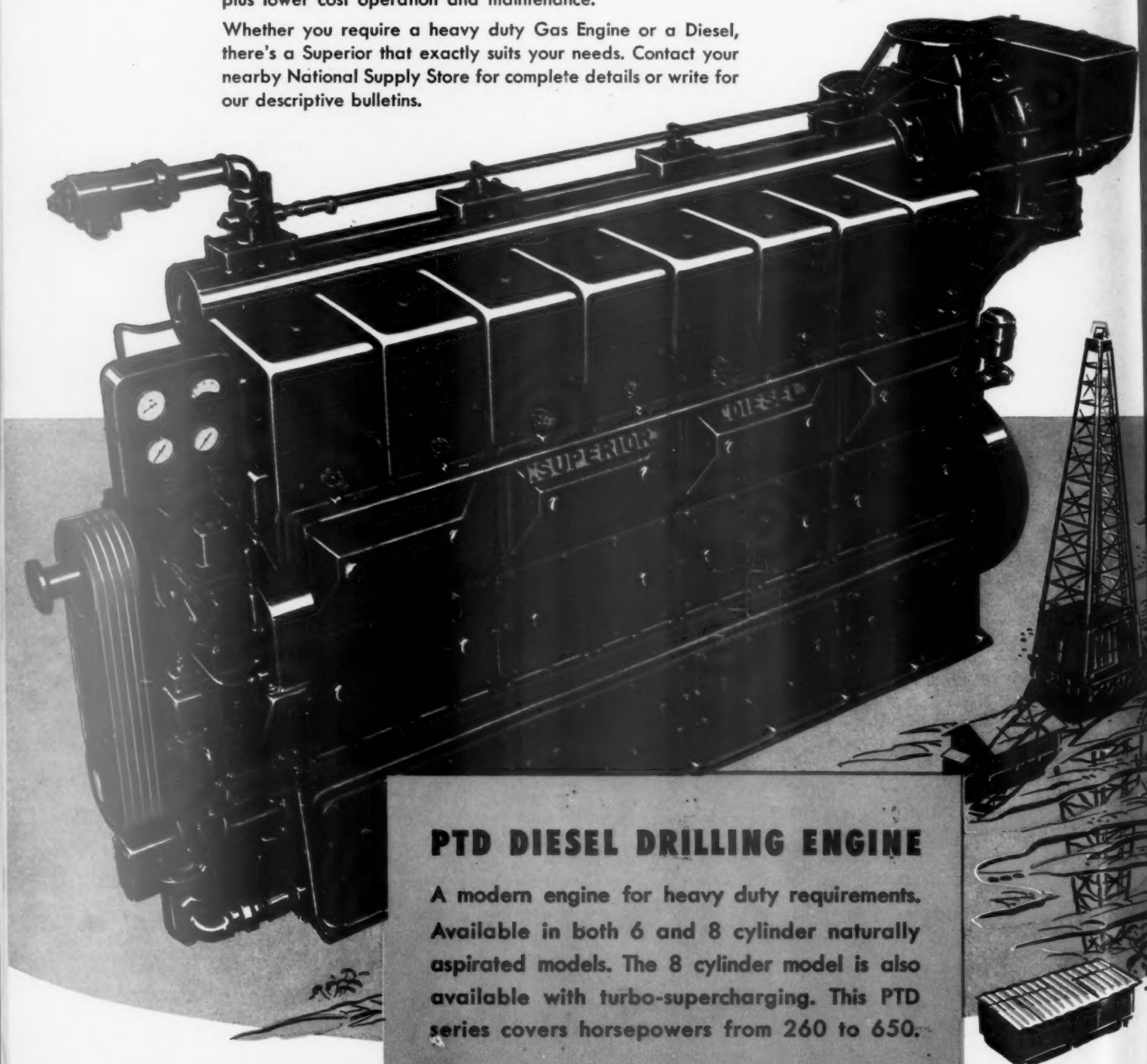
MAKE MORE ROUND TRIPS ..

...WITH THESE *Superior* D

To drive big pumps . . . to pull long drill strings . . . and to get them back faster for more footage, select Superior. Add to this the economy and reliability of these two great engines and you'll easily understand why they're popular in oil fields everywhere.

Superior Engines respond to sudden load changes. Their dependability on the long steady drilling loads is never in doubt. Their ruggedness keeps them on the job . . . for many jobs, and that means better profit plus lower cost operation and maintenance.

Whether you require a heavy duty Gas Engine or a Diesel, there's a Superior that exactly suits your needs. Contact your nearby National Supply Store for complete details or write for our descriptive bulletins.



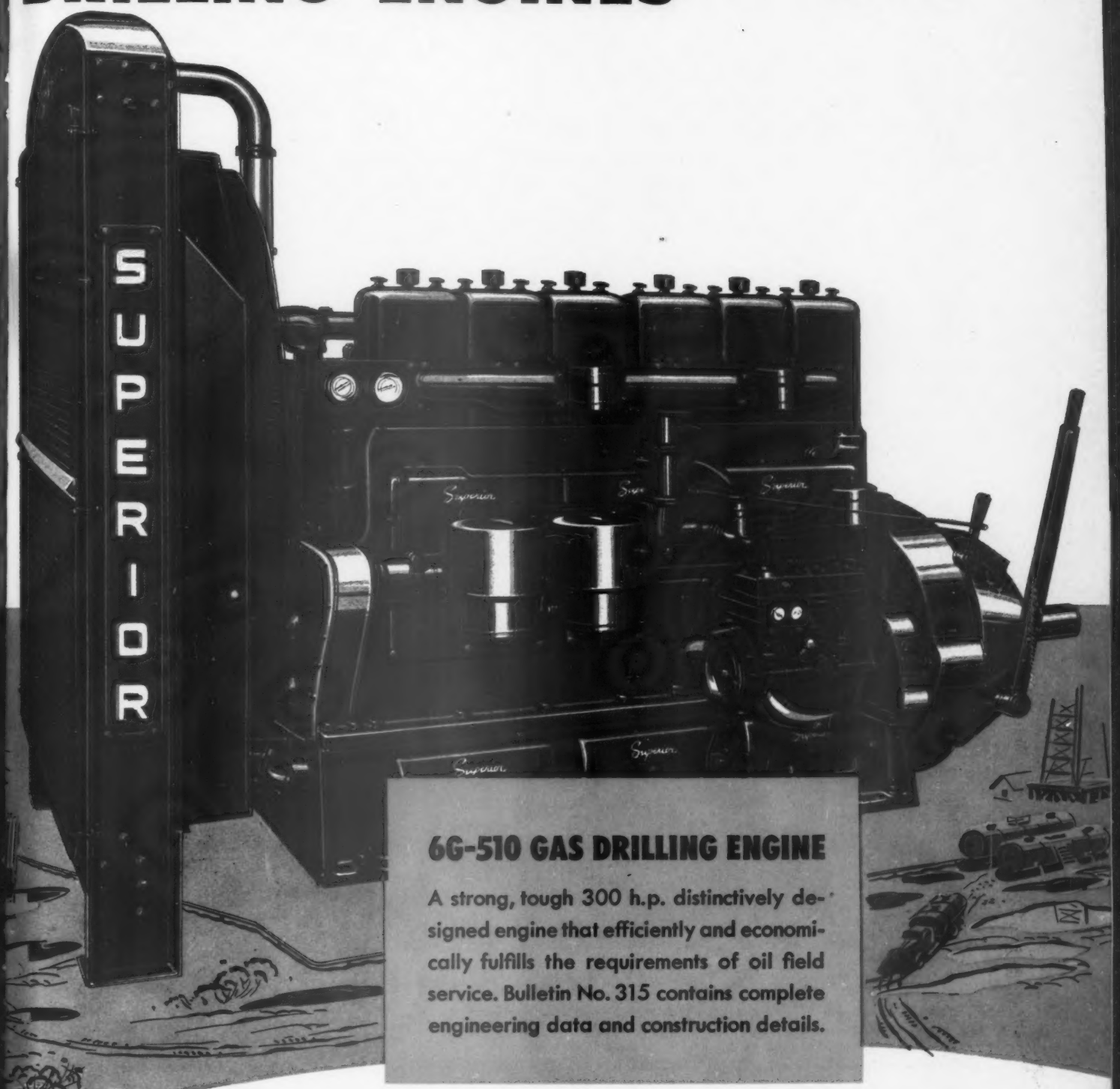
PTD DIESEL DRILLING ENGINE

A modern engine for heavy duty requirements. Available in both 6 and 8 cylinder naturally aspirated models. The 8 cylinder model is also available with turbo-supercharging. This PTD series covers horsepowers from 260 to 650.

FOR DRILLING ★ THE INDUSTRY'S MOST COMPLETE

..FASTER..

DRILLING ENGINES



6G-510 GAS DRILLING ENGINE

A strong, tough 300 h.p. distinctively designed engine that efficiently and economically fulfills the requirements of oil field service. Bulletin No. 315 contains complete engineering data and construction details.

SUPERIOR ENGINE DIVISION OF

THE NATIONAL SUPPLY COMPANY

PLANT AND GENERAL SALES OFFICE: SPRINGFIELD, OHIO

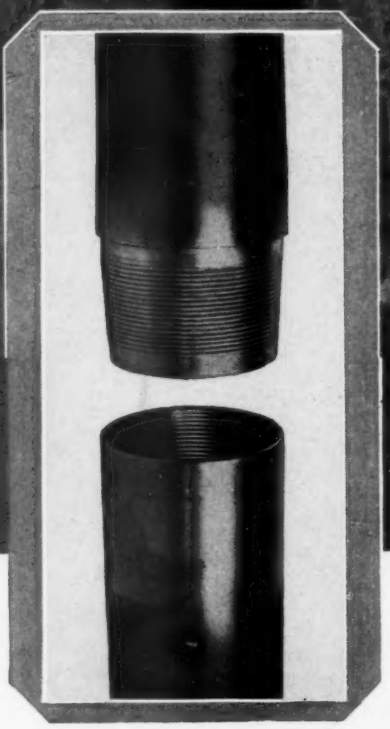
LINE OF OIL FIELD EQUIPMENT ★ FOR PRODUCTION

SPANG
EXTREME LINE CASING
...socks trouble where it lives!

Ordinary casing, joined by a coupling, has two threaded connections at every joint—two chances for trouble to strike.

But Spang Extreme Line Casing is different. On this casing, no couplings are used. Instead, one end of the pipe is upset for a female thread and the other for a male thread. Thus, the number of threaded connections on a string are cut in half—reducing by 50% the chances for trouble.

This one feature alone has played a major role in reducing leakage and other joint troubles. But Spang Extreme Line Casing has seven other features, listed below, that assure fast, safe, sure make-up.



ONLY SPANG EXTREME LINE CASING has all of these 8 advantages

1. High Joint Strength
2. Positive Resistance to Leakage
3. Minimum Outside Diameter at Joint
4. Maximum Speed in Running
5. Stream-lined Exterior Contour
6. High Resistance to Damage
7. Internal Flush Joint
8. 50% less Threaded Connections than A.P.I. Casing

SPANG-CHALFANT

DIVISION OF THE NATIONAL SUPPLY COMPANY
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★ THE INDUSTRY'S MOST COMPLETE LINE OF OIL FIELD EQUIPMENT ★

"Tubing?...Yes, I know where we can get it

"In *our* business we can't afford to get caught short. Constant market changes, unstable conditions, and our large volume requirements compel us to keep tab on a lot of suppliers—both actual and potential.

"So when the Chief asked about tubing, I was able to pop right back, 'Sure, I know where we can get it.' I knew that we could send steel to Nikoh and get quick service on the big quantities of tubing we need."

NIKOH

for welded steel tubing, pipe, conduit

NIKOH TUBE COMPANY • 5001 South Kedzie Ave., Chicago 32, Ill.

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5. Heating, ventilating, air conditioning
6. Machinery, metalworking
7. Railroad, marine
8. Refrigeration
9. Petroleum
10. Automotive, aviation

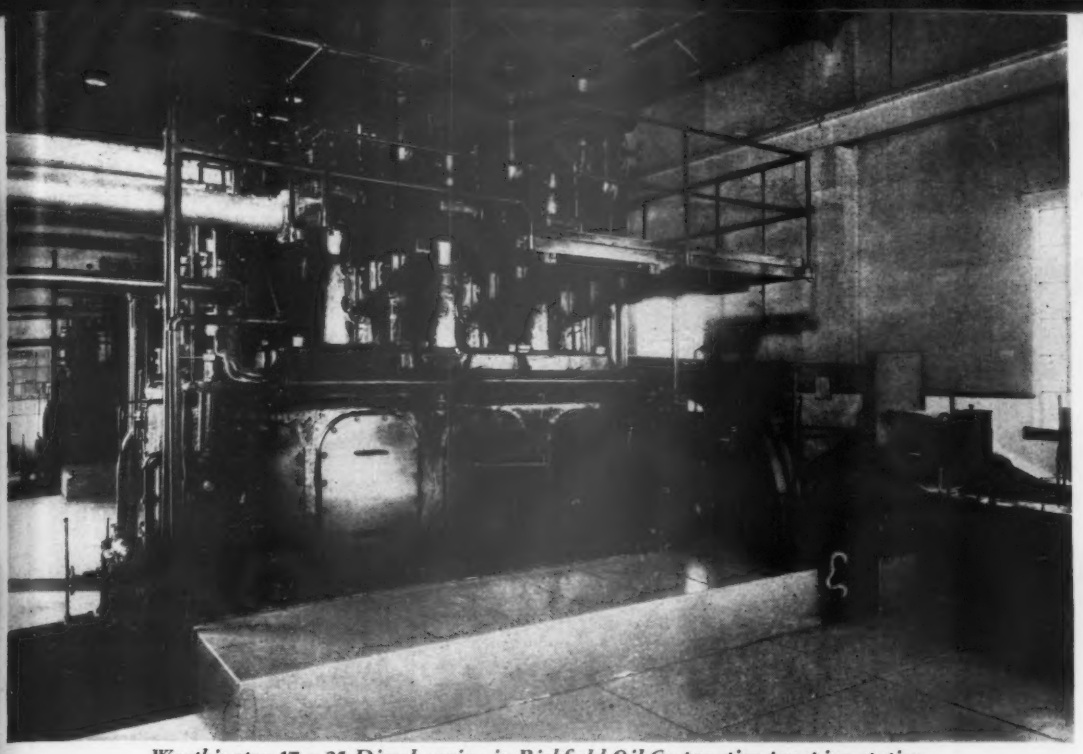
Nikoh has plant capacity available for fabricating welded steel tubing (½" to 4" OD), pipe (¾" to 6" ID), and conduit (½" to 2"). Formed and welded with efficient new equipment that assures uniform quality, accuracy to specifications, prompt shipments, and moderate price. Consult Nikoh on your problems of engineering and production.

NIKOH TUBE COMPANY 5001 S. KEDZIE AVE., CHICAGO 32, ILL

NEWS

FROM THE PETROLEUM FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON



Worthington 17 x 25 Diesel engine in Richfield Oil Corporation pumping station

How Much Wear Should an Engine Suffer in 23 Years?

In 1924, ten Worthington 17 x 25 3-cylinder air injection Diesel engines were installed on the Richfield Oil Corporation's pipe line from Taft to Wilmington, Calif., to drive pumping equipment.

This 10-inch pipe line extends 127 miles, crossing coastal mountain ranges, and carries crude oil varying from 22 to 32 deg., API, at a rate of 27,000 to 33,000 barrels per day and a discharge pressure of 550 to 700 psi. There are five pumping stations, in each of which are two pumping units. The engines are rated 300 hp at 200 rpm.

The engines were put into operation early in 1925 and have been in virtually continuous service since then. Shutdowns over the 23-year period have been only for routine maintenance.

In 1948, a reconditioning program was begun, involving dismantling to a point permitting inspection of all wearing parts. Of the engines thus far overhauled, the maximum cylinder liner wear encountered was found to be .050 in. The Richfield company considered that with so little wear it would not be necessary to replace the liners or pistons.

Main bearings and Conrod bearings (with the exception of a single Conrod bearing) were found to be in excellent shape and were merely cleaned up and returned to service.

This performance is considered to be extremely good in view of the somewhat unfavorable conditions of cooling water and temperature. At most of the stations there is a scaling problem and it is necessary periodically to remove scale from jackets. Temperature of the water ranges from 80° F in winter to 100° F in summer.

Chemicals From Natural Gas

One of the first plants in the Texas territory to produce chemicals from hydrocarbons obtained from natural gas is Celanese Corporation of America's "Chemcel" Plant at Bishop, Texas.

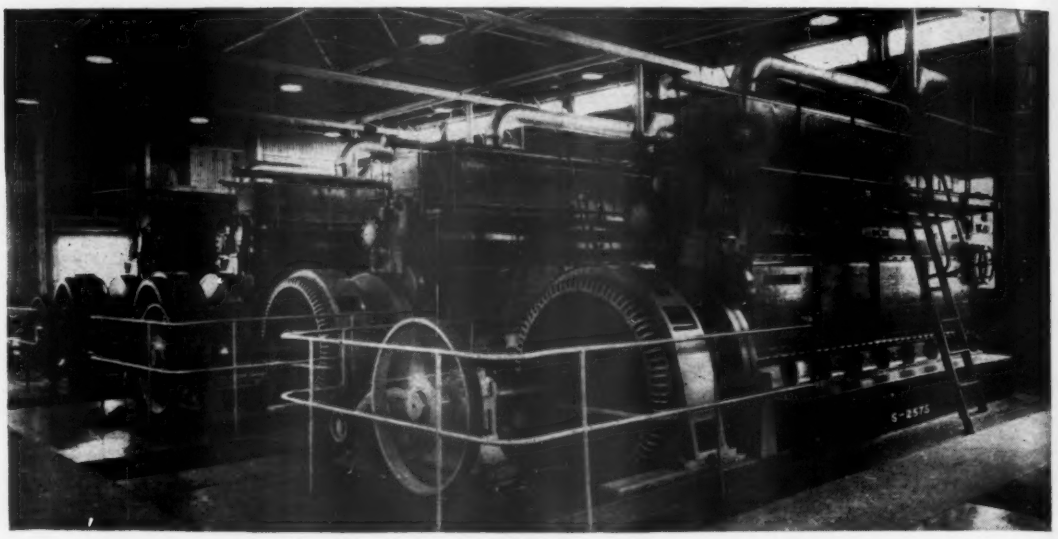
The photograph shows a view of ten Worthington LTC-8 Angle Compressors, representing a total of 10,000 hp, processing formaldehyde, acetaldehyde, and acetic acid.

These ten compressors are only a portion of the thousands of dollars worth of Worthington equipment in use at the Celanese Corporation's Bishop plant. Among the other Worthington units are four-cycle gas engines, driving water circulating pumps, and between four and five hundred Worthington pumps of various sizes and types. Many of the pumps are "Worthite" Chemical Pumps.

Worthington Angle Compressors at Celanese Corporation's plant in Bishop, Texas

NEWS

from the petroleum front



Worthington natural gas engines for electric power generation.

Much Going on in Notrees, Texas

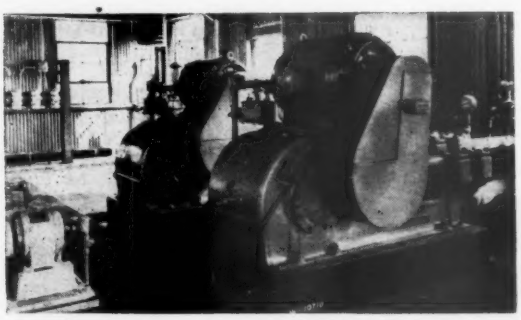
Shell Oil Company's TXL plant at Notrees, Texas, is processing 50,000,000 cu ft of raw gas per day for the purpose of recovering butane, propane and gasoline. There is a large quantity of dry natural gas left as a by-product and this is sold to a natural gas pipe line company for distribution and sale domestically and industrially.

Worthington pumps and gas engines take part in this enormous operation by—

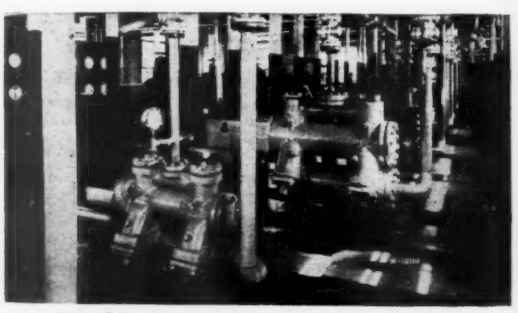
1. pumping finished products through a pipe line from point of storage to point of delivery. Worthington 5 x 10 KMS-1 power pumps are used, discharging against a pressure of 500 psi. Two 4½ x 12 KUF pumps are used when the discharge pressure is expected to near 1000 psi.

2. handling such duties as still reflux service, still transfer service, deethanizer feed, deethanizer reflux, depropanizer reflux, debutanizer reflux and condensate pumping. Worthington Hivol pumps of various sizes are used.

3. providing the power for the plant's entire electric requirements. Four Worthington DDG-8 natural gas engines are used, driving 525 kw generators—all units being derated for 3000 ft altitude.



Worthington power pumps at Shell's Notrees plant.



Worthington Hivol pumps on various duties.

Loading Cargo at 5,000 GPM

At the Union Oil Company's Oleum Refinery in California, two Worthington No. 12 GR Rotary Pumps with 450 hp motors and gears, are pumping over 5,000 gallons of fuel oil per minute, from elevated storage tanks down to the tankers at the docks. The pumps are handling grades of fuel oil up to No. 6.

Worthington Pumps loading cargo at Union Oil Company's Oleum Refinery. →

and Flanged Mountings

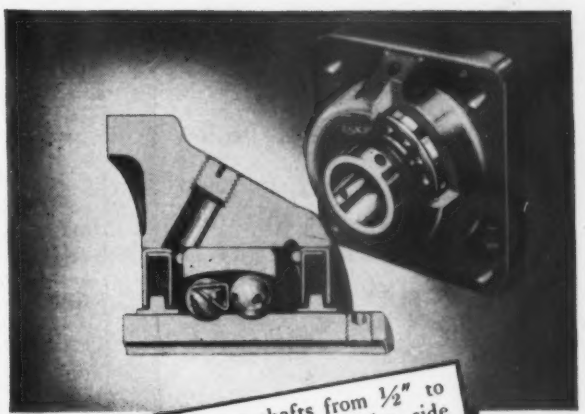
ROLL ALONG WITH SKF!

How many times have you asked: "What type of mounting shall I use where a pedestal support is not available, but where the housing must be attached to a surface at right angles to the shaft?"

SKF provides the right answer with these compact Flanged Mountings that are packaged for immediate assembly. These mountings assure high capacity in a small space . . . are equipped with SKF Self-Aligning Ball Bearings and SKF's exclusive Align-O-Seal.

Remember, SKF *alone* makes a *complete* line of ball and roller bearings, pillow blocks, and flanged mountings. Write us for the address of your nearest Authorized SKF Distributor. 6532

SKF INDUSTRIES, INC., PHILA. 32, PA.



FUS For mounting on shafts from ½" to 1¼" in diameter against the side frame. Equipped with SKF Self-Aligning Ball Bearing and SKF Align-O-Seal. Top plug for periodic lubrication.

FUA For mounting on shafts from 1 7/16" to 2 7/16" in diameter against the side frame. Spider flange construction permits access to extended sleeve nut for quick removal . . . allows free air flow around bearing housing.

● *TYPE FUAR when equipped with SKF Spherical Roller Bearing.*

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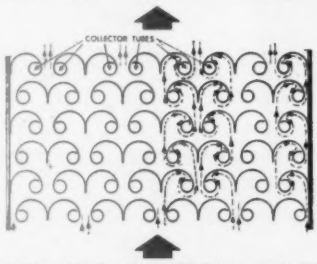
DRY GAS OR LIVE STEAM



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New baffle principle completely knocks out *all* liquid and mist from *any gas or steam.* Exceptionally *high capacity.* Write for complete, descriptive MIST-D-FIER Bulletin.

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Exceptional opportunity offered engineer with experience in the fundamental design and operation of natural gas processing equipment. Primarily want person with ability and knowledge to direct and supervise engineering program and assist in sales. Letter of application should include photograph, personal data, records of education and experience, references, and expected salary range. Box 91, c/o The Petroleum Engineer, Box 1589, Dallas, Texas.

We have an opening in our organization for a Sales Engineer who is a graduate Chemical Engineer or a graduate Petroleum Engineer with considerable refinery experience behind him. This is a splendid opportunity to eventually command a splendid salary with a young growing organization. Salary will be based on training and experience. Write giving training, experience, and personal details, to Allan Edwards, Inc., 505 McBirney Building, Tulsa, Oklahoma.

Industrial Relations Adviser

Frank Pickell, manager of industrial relations for Stanolind Oil and Gas Company, has been named advisor in industrial relations for the company. Robert S. Newhouse succeeds him as manager of the industrial relations department.

Pickell, veteran Stanolind production and industrial relations man, has managed the company's employe relations program for five years. He joined Stanolind in 1931 and in 1942 was made superintendent of operations.

Newhouse, a graduate of Washington University, comes to Stanolind after nine years on the staff of Industrial Relations Counselors, Inc., New York City.

He was associated with Kroger Company for 10 years.

WANTED:
SALES ENGINEER

Long established firm, doing large national business, is desirous of employing man, 25 to 30 years of age, having mechanical engineering degree, to contact equipment manufacturers and supply companies in the petroleum and allied industries. Experience preferred. Salary open for discussion. Write Box 92, care The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

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ENGINEERED FOR EFFICIENCY
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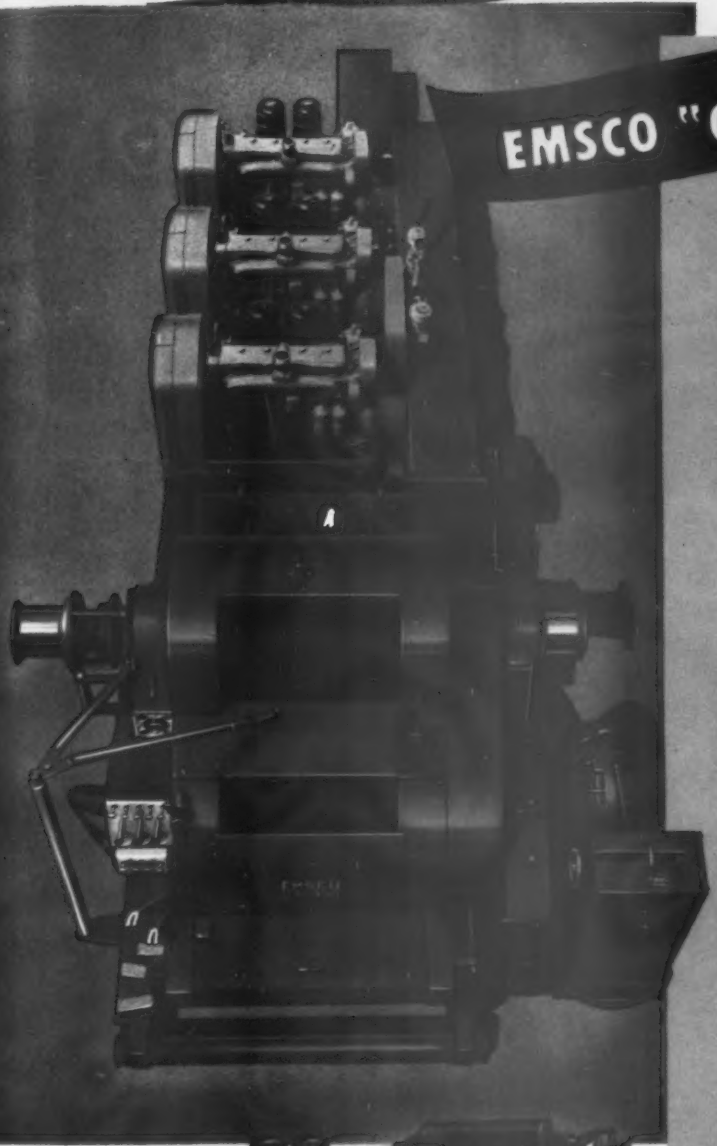
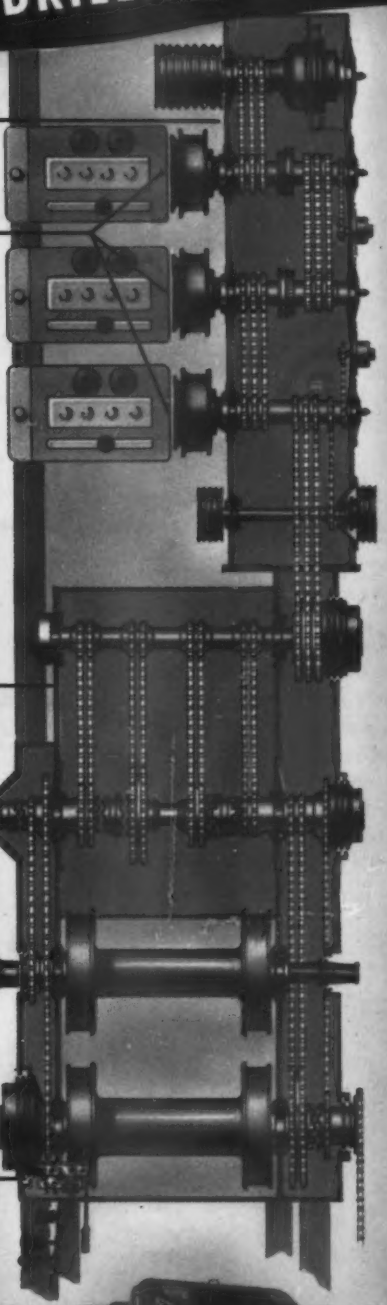
EMSCO "GA" SERIES DRILLING RIGS





Two or three engine compounding transmission provides maximum flexibility.

Fawick Airflex clutches on engines facilitate rigging-up and dismantling.

Compounding transmission and drawworks mounted on common skid base.

Drawworks has built-in selective speed transmission providing six hoisting speeds, three rotary speeds, one reverse to the drum and one reverse to the rotary.

Catshaft designed to accommodate standard makes of catheads. Rig may be equipped with, or without sand reel.

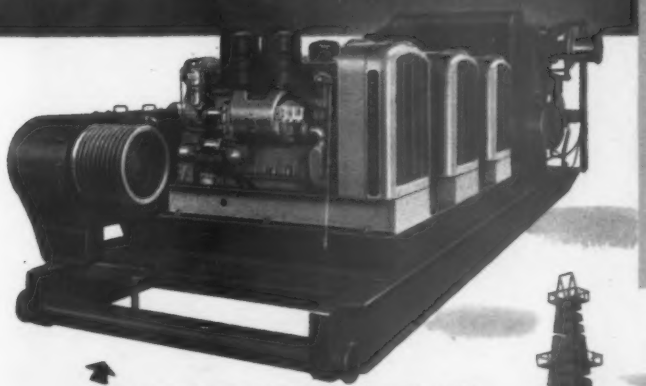
All drives totally enclosed and flood-lubricated from built-in oil pumps. No grease fittings used except on brake linkage.

OIL LUBRICATED AREAS

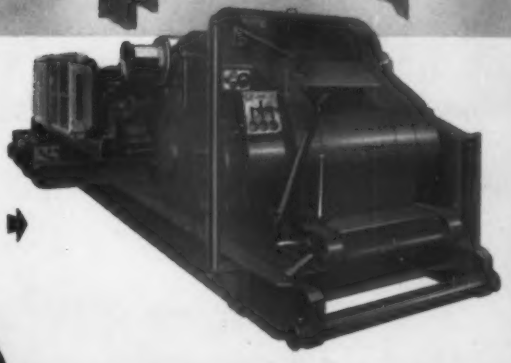
Direct air-operated friction clutches provide smooth, high-speed operation.

AIR-OPERATED CLUTCHES

All controls conveniently located at driller's position.



Rear View of Emsco GA-350 Drilling Rig. With certain makes of engines on a 3-engine, 350 hp. rig, the engines are mounted on a common skid base and the complete rig meets eight foot road clearance requirements. Push button air controls are provided for operation of the jaw clutches in the selective speed transmission.



Front View of Emsco GA-500 Drilling Rig. A 500 hp. rig designed and engineered for faster, safer and more economical drilling of medium depth wells. Optional equipment for both rigs includes sand reel, rope rollers, rat hole digger, wash down pump, hydromatic or dynamatic brake, Thyrite generators, guards, etc.

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Emsco has designed and engineered a complete line of drilling equipment which so far surpasses the needs of today that it may well be called *"the answer to tomorrow's drilling problems."*

Shown here is the Emsco Companion Equipment designed for 16,000 foot drilling.

J-1600 DRILLING RIG—1600 horsepower, complete air-operated controls, incorporates all the well known advantages of the Emsco "J" series, plus many new features.

Series "J" 20½" ROTARY MACHINE—spiral bevel gears, 250 tons dead weight load capacity.

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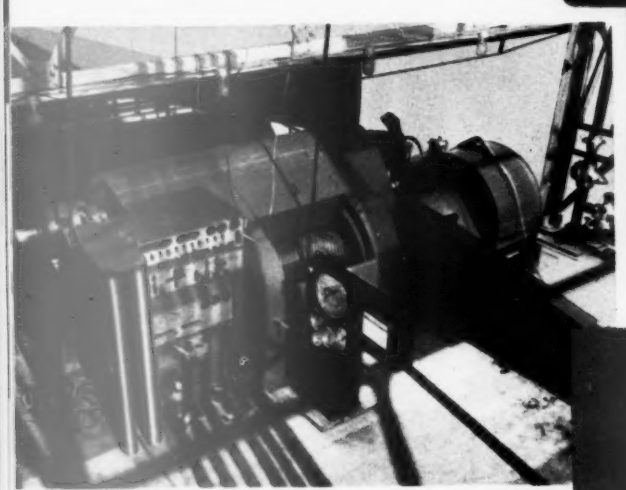
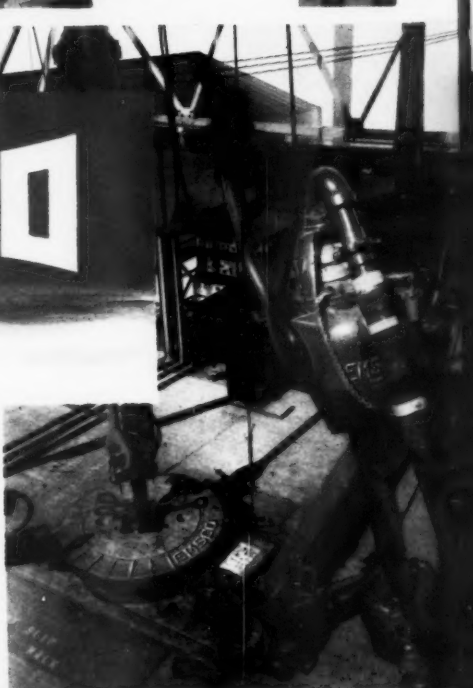
Type "H" SWIVEL—Cartridge type wash pipe packing. Extremely heavy-duty construction for trouble-free operation.

18 AR DERRICK—API 136', 30' base Derrick. Taller derricks are available.

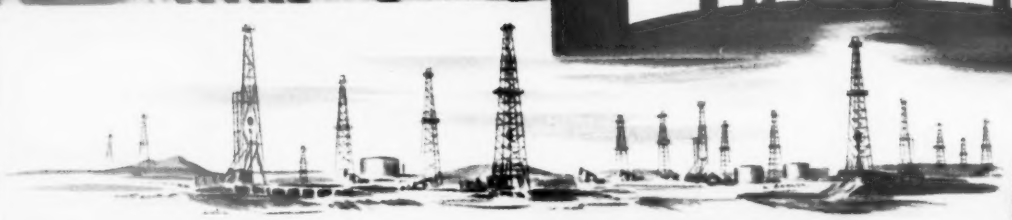
Emsco Companion Drilling Equipment is available to meet any drilling requirement.

Ask Your Nearest Emsco Representative for Complete Information





EMSCO



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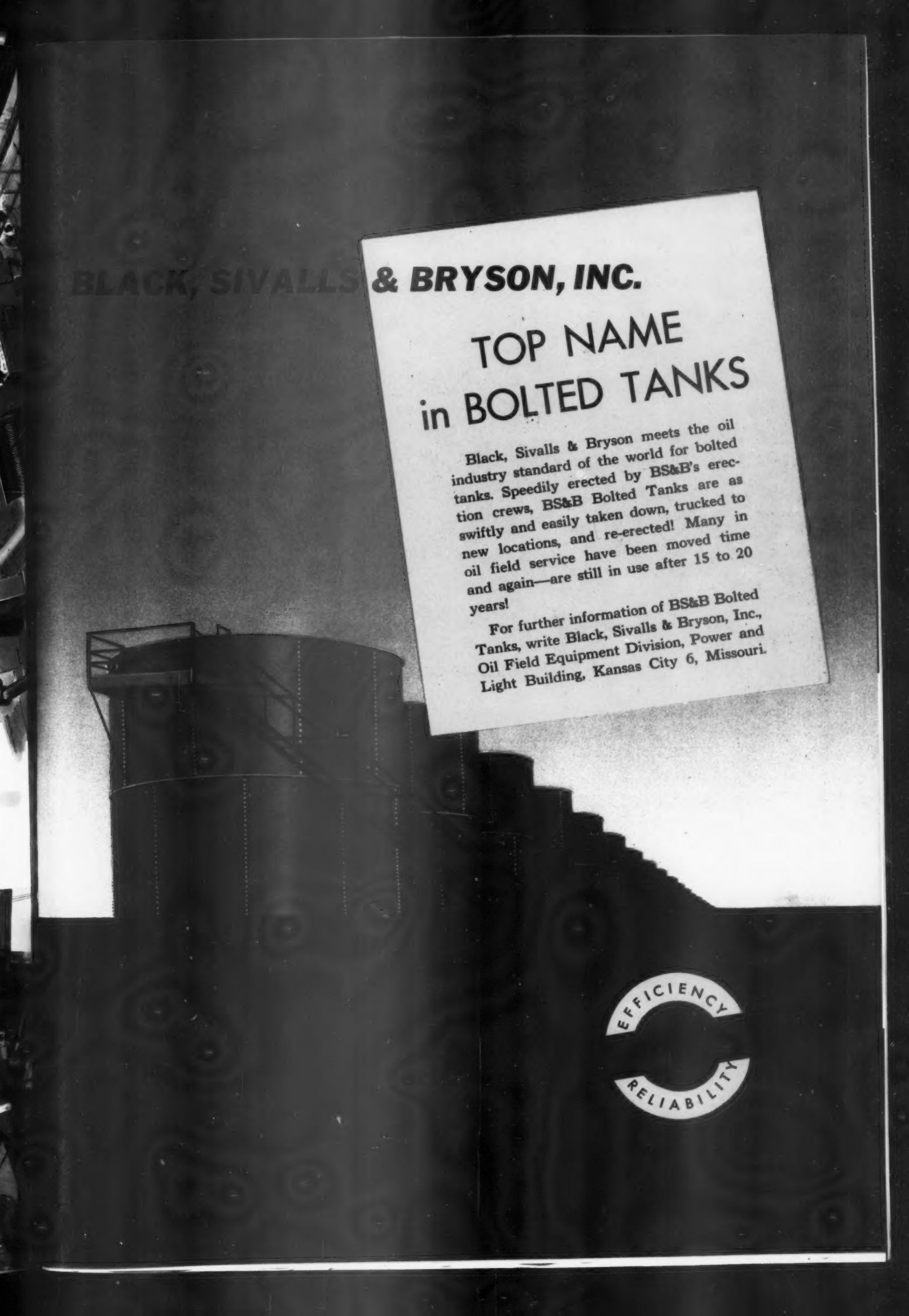
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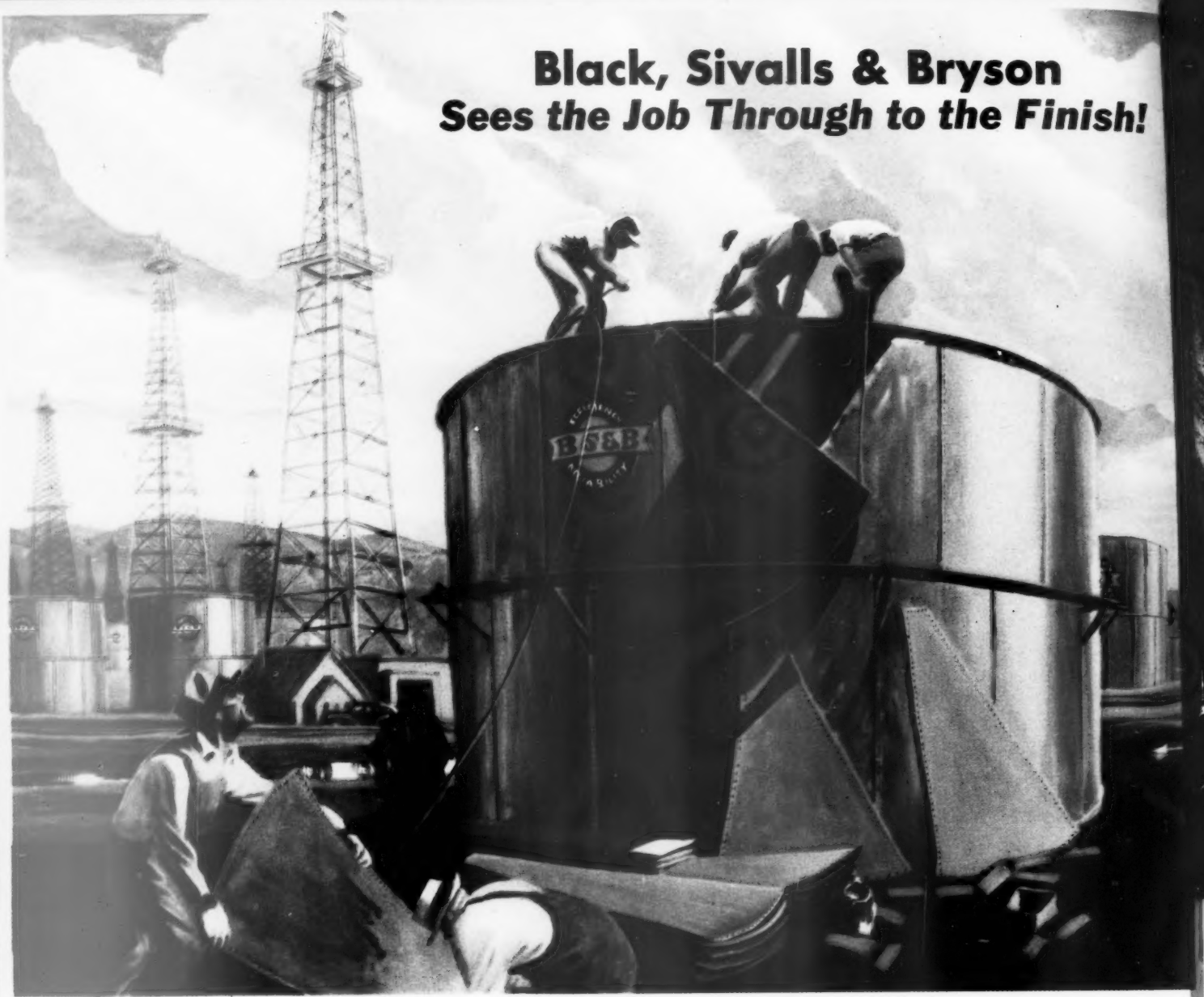

"Up she goes" in short order, as the Black, Sivalls & Bryson erection crew completes another Bolted Steel Tank installation. Day or night, rain or shine, these skilled workers are available for experienced, skilled service on oil field equipment. BS&B branches are located near every producing oil field.

When something happens, it happens in a hurry in the oil business. Steps must be taken quickly . . . and correctly . . . when a well comes in. That's why oil men depend on the Black, Sivalls & Bryson branch close by every producing field.

BS&B tank erection crews are frequently called upon to do an installation job from grading and setting the concrete foundation through the bolting and sealing of the staves and connecting the pipe—all in twenty-four hours.

BS&B renders this service to its oil field customers at no material profit—just another means of building and preserving customer good will.

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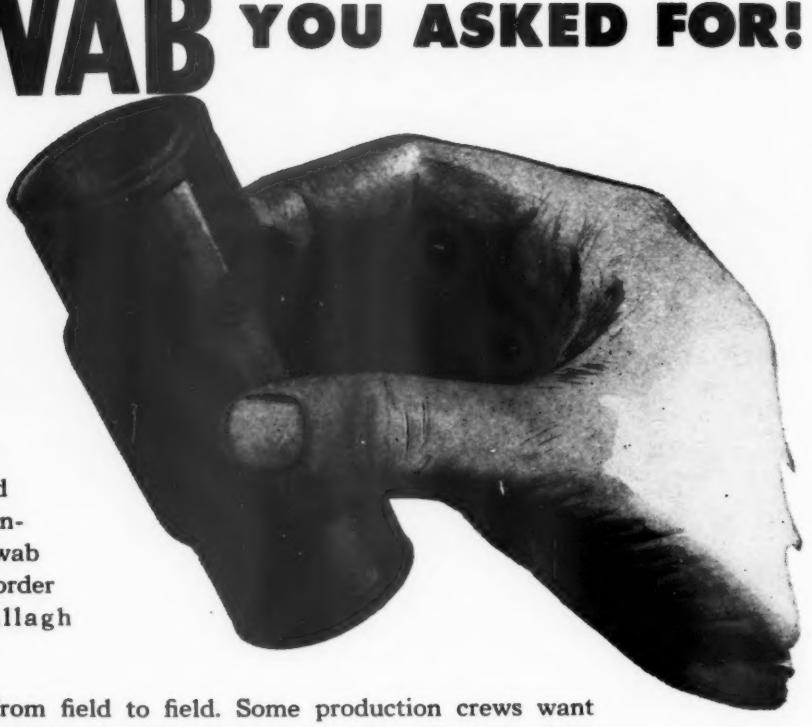
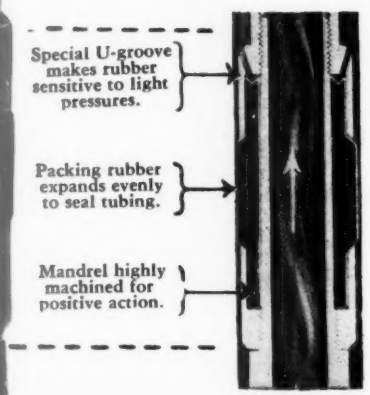


Old hands at swabbing all over the country told us the kind of swab they needed and what it should do. Patterson-Ballagh set out to make a swab that would do it. It was a big order but now the Patterson-Ballagh Deep Well Swab fills the bill.

Methods of swabbing vary from field to field. Some production crews want a gentle swab with sensitive packing rubbers that expand under light fluid loads at slow line speeds; others need to lift deep, heavy loads rapidly. The normal rubber o.d. must be small enough to allow *fast dropping* through restricted and paraffin coated tubing. For the same reason, a large internal fluid passage is necessary and also reduces the possibility of the swab blowing out of the hole. Besides giving the swab a sensitive "feel," swab rubbers have to be tough, wear and oil resistant; requiring no adjustment and pulling a full load every trip. This is what you asked for in a swab; this is what the Patterson-Ballagh Swab gives you.


Special U-groove makes rubber sensitive to light pressures.
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Our interpretation of an instrument's "ruggedness" is the ability to operate, under the most adverse conditions encountered, on applications for which it is intended.

In addition to being built to operate under outdoor conditions, the construction of the Republic Pneumatic Transmitter is more like that of a precision machine than of the sensitive instrument that it is. The design both permits and requires strength, as the force-balance principle could not be carried out with light, bendable parts. All bearings, levers, pins and other working parts must be heavy enough to carry appreciable loads and are therefore not susceptible to damage in ordinary handling or use.

We repeat—"ruggedness" is an important feature of the Republic Pneumatic Transmitter.

★ ★ ★

The Republic Transmitter is a pneumatic metering device. It employs the force-balance principle to convert process variables such as flow, liquid level, pressure or liquid density, into air pressures which vary proportionally with the process variables.

These air pressures become direct measurements and can be conducted to reading instruments or used as the measuring impulse for the actuation of an automatic controller.

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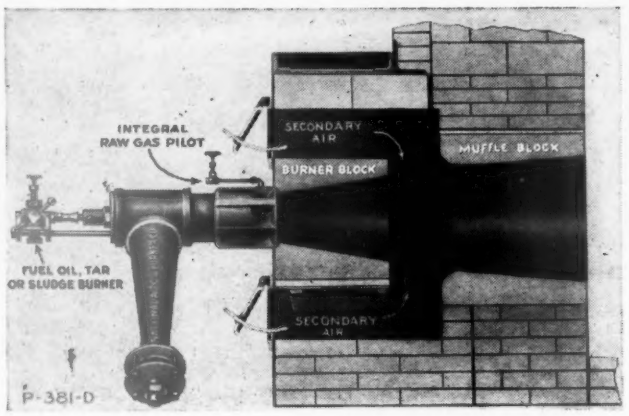

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It maintains a high flame temperature with either fuel oil or gas; can be brought quickly to full capacity with a clean flame; and flame can be regulated and directed to uniformly radiate heat to the absorbing surfaces without flame impingement. The Tandem Combustion Unit is also designed for firing vertically upward and for forced draft preheated air, when necessary. It may be applied to all types of boilers and process furnaces. For details about the Tandem Combustion Unit and the various types available, write

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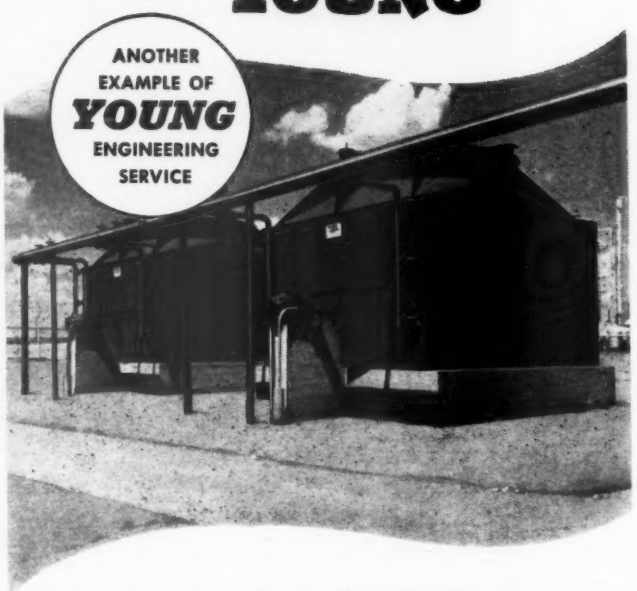

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"VAD" Catalog No. 448 is off the press. It includes details of the sturdy "VAD" construction, specifications, and ratings for the four "VAD" models. Write for your copy today.

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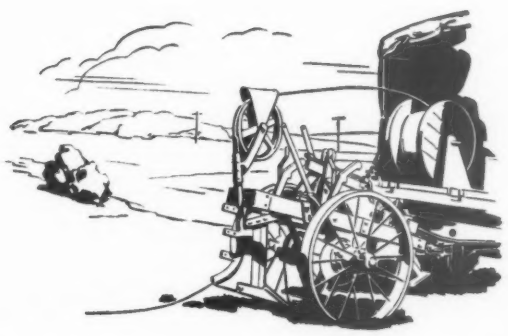
A GREAT *NEW* DOW DEVELOPMENT!



Here's important corrosion protection news for you. It's GALVO-LINE, a revolutionary new type of magnesium anode developed by Dow.

GALVO-LINE is a flexible, continuous, magnesium ribbon anode, cored over its entire length to prevent segregation and provide lasting electrical contact. It's the most powerful of the magnesium galvanic anodes—develops three to seven times more current flow per pound of anode metal installed. With GALVO-LINE, current requirements are at a minimum because the current source is a *line* rather than a point—current is distributed more uniformly and utilized more efficiently at the protected structure.

But that's not all. Look at the picture above and you'll see how GALVO-LINE is installed simply, quickly, and at considerably less cost than conventional anodes. For pipe lines for example, it can be installed mechanically by means of a truck or tractor-driven wire-laying plow fed from a reel of GALVO-LINE mounted on the plow or truck.

GALVO-LINE is versatile, too! It makes the magnesium anode practical for use in relatively high resistance soils. In low resistance environments it exerts a powerful polarizing action which tames corrosion quickly . . . paves the way for a smaller, cheaper, long-term installation. And it's flexible . . . GALVO-LINE can be bent and formed to conform to the geometrical requirements of a variety of different applications.

Get the facts . . . write to Dow.

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for OIL STORAGE TANKS *PAYS OUT!*

Adequate protection against corrosion is not obtained just by applying any "protective coating." The service in which the tank is used must be considered; the tank must be thoroughly cleaned, and then should be carefully inspected by experienced corrosion engineers. The surfaces to be protected should then be properly prepared, primed, and, finally, sealed with a coating designed to give maximum protection to each tank section from the particular type of corrosion encountered therein.

NATASCO assures maximum protection of equipment and investment because:

1. **Natasco engineers make a careful preliminary survey of every job.**
2. **Trained and experienced Natasco crews thoroughly prepare the tank surfaces before applying the priming coat.**
3. **Natasco engineers select the Natasco coating designed for maximum protection in each vulnerable area: Bottom, lower outside ring, B.S. section, vapor space and underside of deck.**
4. **Every Natasco job is *guaranteed to give satisfactory service.***

The NATASCO Company has a complete line of field tested protective coatings, a competent staff of experienced tank corrosion engineers, trained application crews and equipment designed for just one purpose, ***better tank preparation and coating application.***

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